of fixed diameter d inches, and weight w, lbs. per N.M., and of which the dielectric is of diameter D inches and

4,097. "Improvements in magnet cores, applicable to dynamos, transformers, and other electro-magnetic apparatus." R. L. WILLS and J. A. EWING. February 18th.

THE

ELECTRICAL REVIEW.

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THE

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1902 Edition

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500-VOLT ELECTRIC SHOCKS.

THE conclusions which Mr. Trotter draws from the paper read by him before the Institution of Electrical Engineers, are three in number; the dangers have been much misunderstood, greatly exaggerated, and little investigated. With the last we are in cordial agreement; the dangers may also have been misunderstood, but with regard to being exaggerated, we feel bound to join issue with the author, whose paper we take it, is, unwittingly enough so far as Mr. Trotter's good intentions are concerned, likely to do more harm than good.

Presumably Parliament has placed the safety of the public in the hands of the Board of Trade, to which Mr. Trotter is the technical adviser. It seems only right, therefore, that every electrical employé, whether in a factory, sub-station, in the street, or anywhere, should be "looked after" by someone who is likely to know more about the matter than a Coroner. We mention this latter hard-worked official, because Major-General Webber would seem to prefer to let a Coroner and his merry men settle whether blame is to be attached to employers in case of a fatal accident.

Some sub-stations have been death-traps, and so have some switchboards also. Surely, five switchboard accidents in a year (1900) shows that switchboard attendance is a somewhat dangerous occupation.

Let us look for a moment at a sensational article which appeared as a "Special" in the *Pall Mall Gazette* of the 6th inst. We reproduce it in its entirety, without attempting to correct any of its original phraseology:—

The published reports of the paper read a few days ago, before the Institution of Electrical Engineers, by Mr. A. P. Trotter, electrical adviser to the Board of Trade, omitted to describe the interesting practical demonstrations with which Mr. Trotter accompanied his theories. Mr. Trotter lectured on "Electric Shocks at 500 Volts"—the standard pressure by which British electrical railroads, the Central London "Tube" among the number, are worked. It was his aim to prove that, except under extraordinary conditions, no serious danger need be anticipated from a shock of this strength. Popular belief to the contrary he set down as due to ignorance, and to "modern journalistic sensationalism," although it was admitted that even "the technical press and eminent practical electrical traction engineers seem to have a horror of 500 volts."

To show that all this was "mere superstition," Mr. Trotter had provided himself with a complete section, about 6 ft. in length, of the "Tube" track, specially prepared and tested by Major D'Alton, chief engineer of the Central London Railway. This section was placed on the lecture platform, and a current of 500 volts turned into the centre rail, which (as in the "Tube") was uncovered. Mr. Trotter first stood with one foot on the current and one on the outer rail without experiencing any shock. He then deliberately sat down upon the live rail, and lay with part of his body on an outer rail and part on the live rail, equally without sensation. The ordinary evening dress which he wore was apparently sufficient to resist shock.

Next, having removed his dry boots and substituted shoes which had been in the wet for about two hours, he stepped on the rails again with a negative result. On touching the live rail with his finger while in this position, however, he received a smart shock, such as one receives from the familiar galvanic battery. Finally having soaked his handkerchief in water and placed it on the live rail, he was able to sit on the outer rail and touch the handkerchief

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edged plate is placed near to break up the cut shavings. When two records are to be made simultaneously the apparatus is duplicated; two tablets and two recorders with a common mouthpiece and carriage are employed; and the carriage is permanently attached to the recorder.

armature coil has an additional closed winding, or two stationary closed circuit coils are placed diagonally in the main field. The meter may be used for alternating currents of any frequency, or continuous currents, without alteration. 3 claims.

with his naked hand for varying intervals, experiencing only "slight pinpricks, without any perceptible after-effect."

Now the first thought which would strike one on reading this instance of "modern journalistic sensationalism" is, from where did Mr. Trotter get his 500-volt pressure?

It was from a testing battery of Messrs. Sutherland and Marcuson, as illustrated on page XXIX. of our business pages for last Friday, so it is no wonder that the smart shocks were only such as one receives from the familiar galvanic battery. The makers were good enough to send us a box containing 50 cells, which gave an E.M.F. of 50 volts only, with an internal resistance of 70 ohms. It is evidently out of order, and possibly so was Mr. Trotter's; but anybody who has ever been engaged in the operation of cable testing must have frequently received shocks from batteries—good-sized Leclanchés—of 500 volts, with the result of a burned finger, but nothing more serious. Such a battery would probably have an internal resistance of 500 ohms or more, which, added to the body resistance, prevents a dangerous current from passing. Moreover, if the external resistance becomes so reduced as to be just equal to the internal, the difference of potential between terminals is reduced to half of what it is when the external resistance is high compared with the internal.

We look upon these manifestations of Mr. Trotter, therefore, as unworthy of serious thought, as they cannot be considered the equivalent of what occurs in electric traction working with 500 volts where the generator has no internal resistance to take into consideration.

Again, the exhibitions given by Mr. Trotter are beside the mark. Would he purposely fall down on the track of the "Tube" railway and catch hold of the live rail with one hand and a running rail with the other? A man's first instinct is to catch hold of something to save himself, if he falls or happens to be in danger of losing his balance.

Would he, while inspecting tramways, deliberately grasp the hand-rail (supposing it earthed) with one hand, and *grasp*, not simply *flick*, the trolley wire with the other, each hand being skin to metal? The danger seems to us to lie in being unable to release one's grasp, but we see nothing in Mr. Trotter's paper on this vital point.

It is quite impossible to place limits of voltage upon the numerous and quite different cases of electric shock; death may occur, and has been known to take place, with less than 500 volts, and, on the other hand, shocks from pressures of several thousands of volts have not proved fatal.

The individual himself, or, rather, his physiological condition, plays an important part, and the path of the shock, the current strength, duration of contact, skin resistance, and other factors, all combine to determine whether death shall ensue or whether the victim shall recover.

Sufficient importance has not been given to the question of the resistance of the human body, although it has long been known that such resistance decreases with the increase of the applied pressure.

For instance, let us take a hand-to-hand resistance. The poor fellow who was recently killed in the Alhambra Theatre of Varieties at Attercliffe, Sheffield, affords a good example for what we are about to say, although 200 volts apparently sufficed to bring about his end.

The evidence showed that he grasped a bracket with both hands, and that the current passed from one to the other through his body.

More than 10 years ago, when experimenting with dynamo currents, Messrs. Lawrence and Harries found with metal electrodes the wet hand-to-hand resistance to be only 1,500 ohms, but Dr. Waller gives 1,000 ohms as a minimum.

On July 6th of last year we published a most interesting and highly suggestive paper by Mr. Hooper, on "The Electrical Resistance of the Human Body." Brass rods as electrodes, about $\frac{3}{4}$ in. in diameter, were used for the hand-to-hand tests, the pressure varying from a few volts up to 125. The resistances obtained with a number of examples varied between 1,000 and 2,000 ohms when the voltage employed was 100 to 125 volts. At lower voltages the resistance was much higher, but that the diminution of resistance with high voltages did not depend upon a tighter grip of the electrodes due to muscular spasm was shown by substituting heavy pieces of metal resting upon the open palms.

Experiments with alternating currents yielded the same results, though with a frequency of 130 no one was found willing to endure more than 50 volts.

A significant feature in these experiments was the distinct increase of the moisture of the skin of the palms of the hand after high voltage experiments, and Mr. Hooper further found that the resistance of the body during the first one or two-hundredths of a second, after being subjected to pressures of from 50 to 100 volts, is much higher than that found after the current has acted for several seconds. Who knows, then, but that the resistance of the body, after prolonged contact, becomes a mere fraction of what is usually looked upon as its normal, and that the killing current is not merely one of so many milliamperes, but of amperes? Measurements of body resistance have usually been made with a few cells and a Wheatstone bridge, but this method is absolutely useless to enable one to gather any idea of what current may pass through the body from high-pressure wires.

Moreover, one can readily conceive of a vast difference between direct current and alternating current systems from the capacity point of view, when, under the same conditions, the current through the body from an alternating system may be many times greater than that with the other.

We hope that engineers who have had practical experience in these matters will come to the fore, and show that the technical press has good reason for believing there is real danger in shocks from 500 volts, and that its warnings are not "mere superstition."

We know, for instance, there is always the possibility of an explosion in a steam boiler, and we take every precaution to meet such danger, but we don't play about with a kettle and then tell "the man in the street" that he can go and sit on the safety valve of a high pressure boiler.

We acquit Mr. Trotter himself of any suspicion of sensationalism, but the danger lies in the use the "modern journalist" makes of such experiments, and we cannot rid ourselves of the idea that papers such as these, which seek to minimise, if not actually to ridicule, the effects of the dangers to which many of us may at any moment be exposed, are far more conducive to the increase of fatal shocks than to safeguarding the public against them.

Unter den Linden.
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having soaked his handkerchief in water and placed it on the iron rail, he was able to sit on the outer rail and touch the handkerchief

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THE FINAL LOCALISATION OF "EARTHS" ON LOW-TENSION NETWORKS.

By A. P. McDOUALL, A.M.I.E.E.

An argument which is still occasionally used against the solid system of laying mains, is that it is necessary to open up long lengths of the footway or roadway in order to find a fault, whereas with a drawn-in system, a faulty cable may be pulled out without seriously disturbing the pavement.

The following notes are to show that this is not the case, and that with instruments which are found in every central station it is quite possible to test out and calculate the position of the fault to within a yard or two, when the ground over the fault may be opened, and the cable repaired.

The faulty section having been found by throwing off and testing section by section, the position of the fault may be determined fairly accurately by a loop test.

For the battery, a couple of five-ampere secondary cells may be employed; but as a rule it will be found more convenient to use current from the mains through a bank of lamps where one main is "earthed," or it is permissible to earth it temporarily. A board on which about a dozen lamp holders are fixed and connected in parallel makes a handy apparatus for regulating the current used.

The galvanometer should be sensitive and of low-resistance, and spring or gravity controlled, but good results have been obtained, using the galvanometers in the Silvertown and the Nalder Bros'. standard insulation testing sets, although considerable annoyance is caused by deflections due to the pieces of iron so constantly moving about in public thoroughfares, such as perambulators, bicycles, umbrellas, hob-nailed boots, wired hat brims, &c.

As an example, suppose that the fault is on the negative of a three-wire system, with the middle wire permanently earthed, that it has been traced down to a 130-yard length of 61 12 cable, and that the corresponding positive cable is of the same section, and its insulation good.

Switch off all houses supplied from this length, throw the positive and negative cables dead, and make a good short-circuit connection at one end of them; if the disconnecting arrangements do not allow this to be done thoroughly, a piece of 1 12 copper wire may be soldered or well clamped to the cables or terminals, its exact length between cables measured, multiplied by 61, and the product added to the total length of the two cables, giving a result of (say) 280 yards.

At the other end the galvanometer, with a key in series, is connected across the two cables, and a length of new binding wire is measured off to scale; half an inch to the yard gives 11 ft. 8 in., which is a convenient length for working.

The binding wire is carefully connected across the two cables and supported so as to hang clear of "earth," one pole of the lamp board is connected to a live wire and a wire from the other pole of the lamp board is loosely hooked round the length of binding wire near the negative cable.

A lamp is put into one of the holders on the board, the galvanometer circuit closed, and the hooked wire from the lamps is slid along the binding wire until balance is obtained; then a few more lamps are put in and a shorter zero found, the zero position on the wire is kinked, and the number of half inches of wire between the kink and the negative cable gives the distance in yards from the testing end to the fault.

It is generally advisable to repeat the test from the other end, and take the mid-point of the positions calculated as that of the fault.

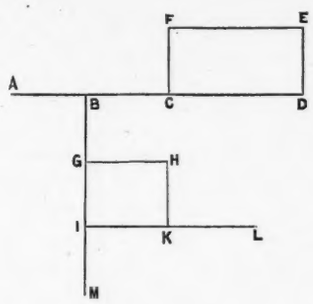
The service cables in the vicinity of the point indicated should be tested before opening up the street.

In the case of long cables, such as feeders and pilot wires, it is often more convenient to do all measuring on a map.

If the section of the cable is not the same all round the loop, or when parts of the loop are composed of cables in parallel, it is, of course, necessary to allow for these in calculating the "length" of the loop, and in measuring up for the fault.

The following gives an extension of this test, which may be useful in cases where the disconnecting arrangements are difficult of access, or where all joints are permanent:—

The diagram represents a part of a two-wire network, which has no disconnecting arrangements.



Testing from A with a short circuit at L, the loop is A B $\begin{Bmatrix} G\ H\ K \\ G\ I\ K \end{Bmatrix}$ L L $\begin{Bmatrix} K\ H\ G \\ K\ I\ G \end{Bmatrix}$ B A, this gives the position of the fault if it is in A B G or K L.

If the position given by this first test is B, cut the faulty cable at, say, F, and test on the loop F E D C F on the one cable only; if this test gives C as the position of the fault, it must lie in B C, otherwise the position of the fault can be measured off at once.

Similarly, other loops, H G I K H, after cutting at H, and L K I M M $\begin{Bmatrix} I\ G\ H\ K \\ I\ K \end{Bmatrix}$ L will give the position of the fault if it lies between G L and M.

One or two lamps in circuit do not very seriously affect a test of this kind, and it is even possible to get a fairly good "localise" on a loop like C D E F without depriving the consumers of the few lights that may be in use in the daytime.

In this case the fault must be a dead earth, the binding wire used for the meter bridge must be thick, and the testing current large compared with the load on the section under test. The main to which the faulty cable has been connected is earthed, and the lamps on the cable under test are thus supplied through earth and the fault, the other cable being kept alive.

ELECTRICAL RESISTANCE FURNACES.

A lengthy article by Otto Vogel bearing the above title has recently appeared in a German periodical, the following portions of which seem to be of sufficient interest to warrant abstraction. Electrical furnaces are theoretically of two kinds, those using the arc, and those heated by resistance; but in practice the two systems are so closely connected that both phenomena may be said to occur in the one apparatus. The essential difference then is rather to be found in the fact that resistance furnaces have the electrode or resistance piece firmly fastened at both ends, whereas arc furnaces are provided with one movable and one fixed electrode. When these furnaces were first employed for manufacturing purposes, the power needed to effect a certain operation was frequently over-estimated, and in consequence arc furnaces were adopted where later experience has shown resistance furnaces to be amply powerful; this is not to say that the latter are only capable of yielding lower temperatures than the former, but rather that in many smelting operations the employment of the arc causes a waste of energy.

In resistance heating, it is desirable that for a given cross-sectional area the electrode shall have the largest surface possible, short of making it mechanically weak, in order that the transference of heat to the material under treatment may be sufficiently rapid. This consideration will affect the shape of the resistance piece; for instance, three electrodes may be constructed each of 1,200 mm. cross-sectional area, the first being circular and 39 mm. in diamenter, the second square and 35 mm. in width of side, and the third oblong, 80 × 15 mm. Per 1 metre in length, these will have surfaces of 122,000, 140,000, and 190,000 sq. mm. respectively, and their efficiencies will stand in the ratio of 6 : 7 : 9.

By making the circular electrode hollow, 30 mm. in internal and 46 mm. in external diameter, the effective surface will be 146,000 sq. mm. per 1 metre in length, with the same section as before; and although it will be only 8 mm. thick in the walls, it will be stronger than the solid cylinder of equal resistance. Other modifications in shape at once suggest themselves, and have been patented at different times.

To test the rate of oxidation in air, a carbon resistance piece 400 × 80 × 15 mm. was treated with a current of 500 amperes. At first the electrode was raised to a bright red heat, but as it burnt away the current density increased, and the temperature rose until it attained that of extreme whiteness. After five hours the test was interrupted and the carbon measured. Its vertical dimension had decreased from 80 to 60 mm., its width at the top had fallen from 15 to 7 mm., its width at the bottom had diminished to a knife edge. From an original section of 1,200 sq. mm. the electrode had decreased to one of 210 sq. mm., or five-sixths of it had disappeared; and the current density had accordingly risen from 0·41 ampere to 2·38 amperes per sq. mm. With the view of obtaining a rough idea of the temperatures to which such a resistance may be raised, an electrode of the same size as before was packed in powdered lime so as only to leave its flat upper surface exposed to the air. The rod was first warmed for 15 minutes with a current of 300 amperes, and then Seger cones, in order of increasing melting points, were laid on its bare surface, the current being strengthened every five minutes. The results of this experiment are best shown in tabular form :—

Amperes per sq. mm.	Seger cone No.	Corresponding temperature.	Metal or substance capable of being melted.
0·25	0·22	590° C.	Up to zinc.
0·33	0·18	710°	—
0·45	0·8	990°	Mg, Be, Ag,
0·54	0·2	1,110°	Au, Cu.
0·66	4	1,210°	Cast-iron, brick.
1·2	24	1,600°	Wrought-iron, lime.
1·6	36	1,850°	Pt, kaolin, fire-clay.
2·0	—	2,300°	Os, Ir, &c.

Above 2 amperes per sq. mm., the foregoing carbon was replaced by a circular rod having an original diameter of 30 mm., which finally fell to 8 mm. The electrode still remained solid at densities of 4 and 6 amperes per sq. mm., and only at 8 amperes did it begin to volatilise, actual melting not being noticed. These temperatures explain how it is that in a resistance furnace calcium carbide begins to be formed at a current density of 1·2 amperes, while a perfectly liquid product is obtained at a density of 2 amperes.

If a carbon rod heated in this fashion is examined, it will be found to have suffered considerably. In the process of its manufacture it is baked at a temperature of 1,300° or 1,400° C., but such a heating does not prepare it to withstand densities of 2 amperes per sq. mm. or upwards. Quite apart from external combustion it will be seen to have become thinner, smaller, and shorter; and since it is firmly fixed at either end, the connections are weakened. The carbon is also affected internally, being converted more into the nature of graphite, and thus it becomes harder and more resistant. In the manufacture of calcium carbide, too, it has to be remembered that not only does the lime of the charge attack the carbon of the charge, but it also attacks the carbon rod; and a similar action will take place whenever any substance is heated in presence of a lime flux.

As already mentioned, lime begins to fuse at a current density of 1·2 amperes per sq. mm., and at 2 amperes calcium carbide is produced freely near the electrode. This action, however, ceases at a distance of 3 or 4 cm., and although the rest of the furnace charge is incandescent, it sinters rather than becomes fluid. This semi-liquid mass then forms a gradually growing lump which conducts part of the current, so that the electrode proper steadily ceases to be the sole source of heat; while the molten carbide permeates the half-solid mass, forming a mixture of good carbide and crust which cannot be economically separated. If, therefore, a resistance furnace has only one electrode, it becomes necessary for the attendants periodically to break up this semi-liquid material, and in particular to prevent the formation of a covering or roof over the carbon rod; an operation which is difficult and unpleasant to perform.

If a resistance furnace is to work smoothly, it requires to be fitted with a set of electrodes arranged gridiron fashion, as has been proposed in Ger. Pat. 120,831, of February 8th, 1900. By this improvement a formation of crust still occurs left and right of the grid, but not above it (so the claim runs); and since the finished carbide constantly drops, by its own weight, to the bottom of the furnace in the shape of stalactites, the raw material on top is always free to descend to take its place. With five electrodes 1,200 mm. long, 100 mm. in vertical, and 15 mm. in horizontal diameter, the weight of the grid is 13·5 kg., its area 7,500 sq. mm., and its resistance 0·003 ω. At a density of 2 amperes, 15,000 amperes are required, which must be introduced at a pressure of 45 volts. This demands about 1,100 (German) H.P., about 920 being utilised in the furnace. But inasmuch as electrodes 1,200 mm. long are not convenient in practice, it is better to have the same length in three separate furnaces arranged in series, and better still, in order to have a reserve, to erect four distinct furnaces with connections so made that three are at work together. Without diminishing the output of carbide, the vertical diameter of these rods may be reduced to 80 mm., so that the section is only 6,000 sq. mm.—an alteration which enables the current density to be increased to 2·5 amperes per sq. mm., if necessary, with the same generating plant. Calculating from the above larger resistance pieces, there is in the three furnaces a total heating surface of 13,800 sq. cm., whereas in arc furnaces with three electrodes each of 150 × 150 mm., the surface would be only 675 sq. cm. Taking the actual make of carbide at 0·2 kg. per H.P.-hour, and assuming that only 900 H.P. are utilised in the resistance furnaces, the yield in each should be 180 kg. per hour, or 540 kg. in all three. The arc furnace gives too concentrated a heat, while the resistance furnace distributes it over a larger area; and so, in practice, the latter method of manufacturing calcium carbide is considered by the author to be more economical.

PARLIAMENTARY.

North and South Shields Electric Railway.

A Committee of the House of Commons, presided over by Lord Elgin on 4th and 5th inst., considered this Bill which seeks to connect North and South Shields by an electric railway under the River Tyne.

Mr. Fitzgerald and Mr. Rollate represented the promoters, and Mr. Erskine Pollock, K.C., represented the Cyclists' Touring Club. There were also several private petitioners.

Mr. Fitzgerald, in opening the case, pointed out the great difficulty experienced in getting communication between two such important towns, for at present the only means of conveyance were some antiquated and inconvenient ferries. He referred to previous schemes which had been brought forward for connecting the two towns, and said that there could be no objection to the present Bill on the ground of any possible interference with navigation. They had agreed upon clauses with the Tyne Improvement Commissioners, who were not in opposition to the Bill. What was proposed in carrying out the scheme was a tube railway of the type with which people were now familiar in London. The railway would commence with a station immediately adjoining the South Shields station on the North-Eastern Railway, so that persons travelling by the railway would be able to get into the underground railway by merely crossing the street. A tunnel would run under one of the main streets gradually descending to the river and passing under it at a proper depth, and the railway would terminate in North Shields at a convenient distance from the existing railway station there. He did not think the desirability of the improvement would be contested. Having dealt with the opposition of members and the public, Mr. Fitzgerald contended that the Cyclists' Touring Club had no right to be heard against the Bill.

Mr. Pollock contended that the Cyclists' Touring Club represented all cyclists, and what they protested against was the charges which had been proposed to inflict on cycles. The Bill proposed to charge 6d. and 1s. for cycles, while first-class passengers would only have to pay a fare of 2d.

The Committee ruled that the Cyclists' Club had no *locus standi*.

Mr. Chas. H. Gadsby, of Westminster, engineer to the scheme, gave evidence, and explained the construction of the railway. He said there would be lifts at the North Shields station, but at South Shields the line would be nearer the surface, and access to it would be by means of steps or inclined ways. The railway would run through a cast-iron tube, the diameter of which would not exceed 13 ft., except at the stations, where it might be widened up to 30 ft. The tube would be constructed with a shield on the same principle that had been adopted, and was now in operation, on the tube railways in London.

In reply to Lord Elgin, Witness said the width of the river at the point where the tube would pass under it was about 1,000 ft., slightly wider than the Thames at the Tower Bridge.

Cross-examined by Mr. Shortt, Witness said the railway might not come nearer the surface than 30 ft. He did not think that with the system on which the line would be worked there would be any serious nuisance arising from vibration. The system would be in accordance with the report issued by the committee appointed by the Board of Trade to inquire as to the vibration caused by tube railways.

Mr. Galbraith, consulting engineer to the promoters, said there would be no nuisance arising from vibration. The dead weight would be taken off the axles.

The Committee found the preamble of the Bill proved, but the consideration of the clauses was postponed.

On 6th inst., the Committee went through and adjusted the clauses, and ordered the Bill to be reported to the House for third reading.

Leicestershire and Warwickshire Electric Power Bill.

On 6th inst. a Select Committee of the House of Commons, presided over by Colonel Welby, commenced the consideration of the above Bill, promoted by the Warwickshire Electric Power Company. Mr. Balfour Browne, K.C., Mr. C. A. Russell, K.C., and Mr. Brydges appeared for the promoters. There were several opponents, including the Corporations of Loughborough and Coventry and the Chilvers Coton Urban District Council (represented by Mr. Claude Baggallay, K.C., and Mr. Square), Aston Manor, Erdington and Rugby District Councils, the Sutton Coldfield Corporation, and the Ashby-de-la-Zouch Urban District Council (represented by Mr. Wedderburn, K.C., and Mr. W. Hutchinson); Mr. Vesey Knox appeared for the Rugby Rural District Council, the Coalville Urban District Council, and Mr. Frere represented the Market Harborough District Council.

Mr. Balfour Browne, K.C., in opening the case for the promoters, said the Bill was one for incorporating and conferring powers on the Leicestershire and Warwickshire Electric Power Company, and although there were a great number of appearances against the Bill, there were a great many petitioners in favour of it, consisting of local authorities, colliery owners and manufacturers. As the Committee were aware, this was not the first electric power distribution Bill that had come before Parliament. There had been a large number of such Bills discussed before Parliamentary Committees in the last two sessions. Those Bills had for their object the bringing of this country into line with other countries, but even then they were seriously behindhand in supplying electricity for power purposes. The first Bill was that which was promoted in 1898 by the General Electric Distribution Company, which extended over a district including Sheffield, Nottingham, and a number of other large towns. In the same year there were several other Bills with similar objects, and Parliament considered the matter so important, that a Joint Committee was appointed to settle the policy which should be pursued in the future, and the recommendations of that Committee had been the foundation of all the electric power Bills that had been brought before Parliament. One of the questions asked with regard to the General Electric Company was whether powers should be given in any case for the supply of electrical energy over an area including the districts of numerous local authorities, involving plant of exceptional dimensions and of high voltage, and whether, if such powers might be given to a company, whether any conditions should be imposed with respect to the system of plant to be used, and the construction and location of generating stations, in view of the powers of purchase conferred upon local authorities by the Act of 1888. The Committee came to the conclusion that the proved public advantage of electric energy in the generating of light and power, warranted the granting to undertakers of compulsory powers for acquiring sites for generating and other purposes. They also recommended that where sufficient public advantage was shown, powers might be given of a company for the supply of electrical energy over an area including districts of numerous local authorities, and involving the use of plant of exceptional dimensions and high voltage. The Committee further thought that undertakings of that character might properly be authorised on somewhat different conditions from those imposed by the Acts of 1882 and 1888. The Act of 1882 had practically stopped the development of the electrical industry in this country, and, accordingly, Parliament, in 1888, passed another Act to remedy the evil. That Act still reserved the power of purchase to the local authorities, but the period of purchase was extended from 31 to 42 years. But the Joint Committee in 1898 went a step further, and said it did not appear to them that an undertaking supplying energy in bulk at high voltage, and in comparatively few mains, was, as a rule, so desirable for a local authority to acquire as a low voltage undertaking with many distributing mains.

By the Chairman: The present Bill was for a high voltage supply.

Mr. Balfour Browne, continuing, said that practically local authorities were, by the report of the Joint Committee, deprived first of their power of purchase for a high voltage undertaking which they might want to have, and they were also deprived of the provisional veto they formerly enjoyed. To some extent that accounted for the large local opposition against his Bill. Local authorities were always very jealous of any private undertakings coming into their district, and in order that the local authorities might have full protection the promoters had inserted the following clause—Clause 40—in the Bill:—"The powers of the company for the supply of energy under this Act shall be subject to the following restrictions:—(1) Energy shall be supplied by the company only to authorised undertakers and to persons requiring a supply for power. (2) The company shall not supply energy for lighting purposes except to authorised undertakers, provided that the energy supplied to any person for power may be used by such person for lighting any premises on any part of which the power is utilised. (3) The company shall not supply energy (except to authorised undertakers) in any area which at the date of the passing of this Act forms part of the area of supply of any authorised distribution without the consent of those distributors, which consent shall not be unreasonably withheld. (4) If any question arises as to whether the consent of any authorised distributor is unreasonably withheld, that question shall be determined by the Board of Trade, and consent shall be deemed to be unreasonably withheld if the authorised distributors are not willing and in a position to give the requisite supply upon reasonable terms and within a reasonable time. (5) In any provisional order to be granted after the passing of this Act by the Board of Trade authorising any local authority, company or person to supply energy within the area of supply under this Act, provision may be made as to the taking over of any supply then given by the company for use exclusively within the area of supply defined in such order." Passing on to explain the Bill, learned counsel said that the district they sought to supply was being very rapidly developed, and it was necessary that it should have the advantages of electrical energy to assist in the development, especially in connection with coal mining, brickmaking, and other manufacturing works. The area proposed to be covered by the promoters was 1,340 square miles. At the present time the number of electric stations actually at work in the district was six, but there were 16 of the local authorities who possessed some powers with reference to electric lighting or tramways. The estimated population in the company's area was 760,000, while the total number of consumers already supplied was only 1,545. The Bill provided for an installation of 30,000 I.H.P. The company proposed to take land compulsorily for six generating stations at Neubold-on-Avon, Leamington, Shustoke, Hinckley, Glenfield and Measham.

The Chairman said that Mr. Balfour Browne might take it that the Committee accepted the general principle of the utility of electricity, but that was totally apart from local considerations.

Mr. Balfour Browne, continuing his address, said that the promoters were mainly local gentlemen who knew the needs of the district, and they had protected the interests of the local authorities by Clause 40.

The Chairman observed that the clause did not contain one paragraph which was in the South Wales Bill.

Mr. Balfour Browne replied that the clause to which the Chairman referred which had been omitted was, in his opinion, an exceedingly bad one, because under it the local authority would be able to fix their own price in their own district, and that would prove disadvantageous to the consumer. His position with regard to Corporations trading was, that they should be subject to the same competition as private companies.

Mr. Mansfield H. Mills, C.E., one of the promoters of the Bill, gave evidence in its favour, and said that a good and cheap supply of electricity in the districts proposed to be served would be of immense advantage to the manufacturing industries there.

In reply to Mr. Wedderburn, K.C., Witness said he did not see that it would be unfair to a place like Sutton Coldfield, which had spent money on generating stations for a company like theirs, to step in and destroy them. In his opinion, the best policy for those authorities, instead of going on under conditions which would make it impossible for them to succeed, should be, "cut their loss" at once.

Mr. Wilkinson, the general manager of the Great Western Railway, also gave evidence in favour of the scheme, as did Sir John Rolleston, M.P., who gave it as his decided opinion that the facilities for obtaining electric power which the Bill proposed would be of great advantage to the industries of the district. On the question of the opposition of local authorities, Sir John said that they were very seldom, if ever, the pioneers in enterprises of that nature. It was generally left for a private company to make a start, and then, if it was successful, the local authority tried to get hold of it. Witness was a promoter of the Bill. He could not see that they were asking for a monopoly—in fact, his experience was that competition in these matters was good all round.

The Committee then adjourned.

At the commencement of the proceedings on Friday, Mr. Balfour Browne asked for an adjournment so that it might be seen if various matters under dispute might be settled without troubling the Committee.

After considerable discussion between counsel, the Committee adjourned until after luncheon.

On the resumption, Mr. Russell said that terms had been arranged with all the parties opposing. A clause had been agreed to which would require some verbal alteration, and he suggested a further adjournment until Monday, in order that the clause might be brought up in a complete form.

The Chairman asked if the Committee were to understand that all opposition to the preamble had been withdrawn.

Mr. Wedderburn said he believed the parties had come to a reasonable agreement, and that the Committee would now not be greatly troubled. Practically what was done was to give to the local authorities that which was given to them in the case of the Yorkshire Bill of last session.

Mr. Russell said that the Yorkshire Bill gave a certain position to all local authorities authorised to distribute, and they were prepared to give a similar position to the local authorities in this case,

with the addition of two authorities not already authorised distributors, who intended to make an application to put themselves in that position.

Mr. Vesey Knox remarked that it was only a question of price with his clients, because they had never intended to generate electricity. They had made an arrangement with the promoters, by which they would have the advantage of getting electric energy at a cheap price for all purposes, and had therefore secured to the inhabitants of the Ashley and Coalville districts an available supply of cheap light and power.

After deliberating in private, the Chairman announced that the Committee would require evidence regarding the prices proposed in the Bill, and they would consider the advisability of conferring power to purchase in the future on local authorities. Subject to those provisions they found the preamble proved.

Mr. Harris, of the firm of Sir Fred. Bramwell & Harris, electrical engineers, of Westminster, said the price was to be revised every 10 years. If they lowered the price to one customer, it must be lowered all over the area, and the price must automatically drop as they found it more easy to supply the current at a lower price. He knew of no electric power Bill in which a purchase clause had been introduced. Such a clause was introduced into one or two Bills, but it was cast out, as it was found to be impracticable. The company would encourage local authorities to obtain provisional orders for the distribution of electricity.

The Committee then adjourned till Monday.

On the resumption of the proceedings on Monday, Mr. Balfour Browne said that while the points of difference with most of the opponents had been settled, yet they had not been able to quite settle terms with the Urban District Councils of Coalville and Ashby-de-la-Zouch. The new clause, 34 F, for the protection of those Councils had been drawn up as follows:—"(1) If within six months after the passing of this Act the Council so requires the company, and the Council shall enter into an agreement containing the following provisions which shall thereupon be binding upon the Council and the company respectively:—(*a*) The Council shall, within two years from the passing of the Act, apply for a provisional order under the principal Acts empowering that Council to supply energy within their district, and on obtaining such order shall take all electrical energy required by them solely from the company; (*b*) The company shall supply electrical energy to the Council at the price of 1½d. per unit, together with an additional ½d. for any transformation to any voltage required by the Council, or such lower price as may be charged by the Council to any authorised distributor whose circumstances are similar; (*c*) The company shall not supply energy within the district save to the Council; (*d*) The Council shall take or pay for in each year such minimum quantity of energy as may be fixed, failing agreement by an arbitrator appointed by the President of the Institution of Civil Engineers, and (*e*) all other provisions usually inserted in agreement for the supply of energy in bulk, and such provisions shall be settled failing agreement by a counsel appointed by the Attorney-General. (2) In the event of the Council not requiring the company to enter into such an agreement as aforesaid, the following provisions shall have effect for the protection of the Council—that is to say—(*a*) Nothing in the Act shall prejudice any application which may hereafter be made by the Council for a Provisional Order for the supply of energy under the principal Acts, and in any Provisional Order to be granted by the Board of Trade authorising the Council so to supply energy, provision may be made as to the taking over of any supply then given by the company for use exclusively within the area of supply defined in such Order. (*b*) After the Council shall have obtained such Provisional Order, the company shall not, without the consent of the Council, supply energy in the district to any person (not being an authorised undertaker or a railway or water company, or the proprietors or trustees of a canal or navigation) who was not supplied by them previous to such place so being the whole or part of the area of supply of such distributing authority." He agreed to the first clause, but he asked the Committee not to sanction the second section. He was quite willing to enter into an agreement, but he did not want the Committee to legislate for the future in case the districts did not enter into an agreement.

The Chairman: What you ask is that Sub-Secs. A and B should be struck out.

Mr. Browne said that was so.

Mr. Vesey Knox said he was content to leave the Committee to deal with the question on its merits. All they asked was that if no agreement were entered into, they should get the same protection as was afforded by Clause 49 in the Yorkshire Bill of last session.

After some further discussion, the Committee deliberated in private, and on the proceedings being resumed, the Chairman said the Committee had decided that Sub-Clauses A and B of Clause 2 should be omitted, and also Sub-Sec. 5 of Clause 40, and that in the place of these three clauses, Clause 49 in the Yorkshire Bill should be inserted.

Replying to the Chairman, Mr. Browne said that other districts taking the same quantity of energy under similar circumstances to Coalville, would obtain the same terms with regard to the supply.

The Bill was ordered to be reported to the House for third reading.

Newport Corporation Tramways.

The Bill of the Newport Corporation was before a Select Committee of the House of Commons presided over by Mr. W. S. Caine on Tuesday, Wednesday and Friday last week. Amongst the powers sought in the Bill are the construction of 11 lines of tramway about 6 miles in length altogether. The estimates in the Bill comprise £110,000 for tramway purposes.

On Friday the Committee deliberated in private with respect to the opposition of the Great Western Railway Company to the running over the level crossings. On the resumption of the proceedings, the Chairman announced that the Committee had decided to grant all the tramway clauses in the Bill, but expressed the hope that before the Bill came before the House of Lords some arrangement might be come to between the parties with respect to the level crossings. The other parts of the Bill were gone into and passed, and it was ordered to be reported to the House of Commons for third reading.

Derbyshire and Nottinghamshire Electric Power Bill.

The Derbyshire and Nottinghamshire Electric Power Bill came on the 6th inst. before Mr. Jeffreys, Deputy-Chairman of Ways and Means, as an unopposed measure. Mr. Brady, the solicitor to the company, proved the preamble of the Bill, which repeals so much of Section 30 of the Act of 1901 as prohibits the construction of stations for generating electricity elsewhere than on lands described in the schedule of that Act. The Bill was ordered to be reported to the House of Commons for third reading.

Brighton and Rottingdean Seashore Electric Tramway Bill.

This Bill came before Mr. Jeffreys, Deputy-Chairman of Ways and Means, on 6th inst. as an unopposed measure. It authorises the Brighton and Rottingdean Electric Tramway Company to divert a portion of their existing and authorised tramway, and construct a new tramway in lieu thereof. Powers are also taken to raise additional capital. The Bill was ordered to be reported for third reading.

Southport and Lytham Tramroad Bill.

The Court of Referees in the House of Commons on 4th inst. considered the objection of the Southport and Lytham Tramway Company to a *locus standi* being granted to the promoters of the Preston and Lytham Light Railway Order, 1901, to oppose the tramway company's Bill now before Parliament in Committee.

Mr. Tahourdine said the Preston and Lytham Light Railway promoters opposed any extension of time as authorised in the Bill, as it would obstruct the making of a junction necessary to construct a through route from Preston to Blackpool.

Mr. Balfour Browne argued that the petitioners had not the slightest ground to be allowed to be heard. The tramway company had already the power to lay down the tramways.

The Committee disallowed the *locus*.

Northumberland Electric Power Bill.

A Select Committee of the House of Commons, under the chairmanship of Col. Welby, commenced on Monday the consideration of the Northumberland Electric Power Bill. The Bill seeks to empower the incorporation of a company to supply a large part of the County of Northumberland with electricity in bulk.

Mr. Balfour Browne, K.C., who, with Mr. Baggallay, K.C., and Mr. W. H. Dickinson, was for the promoters, said that the Newcastle-on-Tyne Electric Company's Bill was a rival measure. The promoters did not seek to supply either Tyneside or Newcastle. The Bill was really promoted by the Northern Counties Electricity Supply Company, Limited, which was established in 1891, and had power to promote Bills. That company had already applied for various provisional orders in the district embodied in the Bill. They had provisional orders in Blyth and Burradon, and had erected a generating station at Blyth, and were supplying there. They had also an order for Alnwick, which was 18 miles further north than Blyth, and a generating station was being erected there. They had also got a transfer with the sanction of the Board of Trade of the order of the Monkseaton Urban District Council, but it was not intended to erect a generating station there specially. The Northern Counties Company had also applied for orders for Bedlington, Morpeth, Ashington, Newbiggin and other places, so that it would be seen they had already a great stake in the district. The Newcastle-on-Tyne Electric Supply Company shared with the Newcastle and District Electric Lighting Company the supply of Newcastle, and the latter company had an agreement with the Walker local authority to supply that district for 10 years. The same company was also allied with the Wallsend Gas Company, and had certain rights; last year they took power to construct tramways from Walker to Wallsend, joining with the Tynemouth tramways in the Tynemouth district. It would be seen, therefore, that the Supply Company had a district of enormous value electrically. Some time ago the directors of the Northern Counties Company determined to promote the Bill now before the Committee, but they left the district of the Newcastle Company alone; they had avoided in any way seeking to go into their district. His company had not so many manufacturers in the district, but they had a great many collieries, and they had the support of the colliery owners of the district. The Newcastle Company were now seeking to obtain powers over a great part of the area scheduled in his Bill; they did not seek to go so far north, but wished to take in a larger area to the west. The scheme of the promoters of his Bill was a simple one. It was to erect two generating stations, one at North Seaton and the other at Cowpen, both in the centre of the district, and the energy there generated would be transmitted to sub-stations. All the energy would be carried underground, so that there would be no danger to the public. It was a remarkable fact that there was not a single local authority opposing the Bill.

His contention was that the Newcastle Company were seeking to invade the territory of the promoters, although they had refrained from invading the territory of the Newcastle Company. As to price, they had a sliding scale when 8 per cent. was reached, while in the case of the Supply Company the sliding scale was to operate when the dividend had reached 9 per cent. It seemed to him that the only argument which could be brought forward in the case of the Newcastle Company was that they already had a generating station at Tyneside, but that generating station would not be capable of supplying the energy required for the new district, and, as a matter of fact, he believed arrangements were now being made for putting up another generating station. If that was so, the Newcastle Company would not be in a position to supply earlier than his company. At present the Newcastle Company had an area of 30 miles, and they sought to extend that to 300 miles. He asked the Committee to say that the promoters of the Bill before them should be left alone, although he did say this, that they would take their Bill, even though the Newcastle Company were allowed to come into the district, because they believed they could supply cheaper than the Supply Company.

Mr. C. S. V. Brown said he was engineer, with Mr. Fairweather, of the Northern Electric Supply Company, Limited. It was proposed to erect two generating stations—one on the River Blyth, and one on the River Wansbeck. The sites were chosen because of their nearness to the collieries, and also because of the supply of water for condensing. Each station would be of the capacity of 8,500 kw., or 11,330 h.p. They could erect the North Seaton station first, and they anticipated that this would take 12 months to build. The Northern Counties Company had a generating station at Blyth, and so was in a position to supply now. The Newcastle Company was supplying a fat commercial district at present from a station with a capacity of 5,000 kw. He understood it was the proposal of the Newcastle Company to make a new station at Wallsend, and that they already had power to erect that station, but he did not think they would be in a position to give a supply to the district before his company. Indeed, his company could supply earlier from the Blyth station. The furthest point to which they might be called upon to convey electricity was 18 miles, whereas in the case of the Newcastle Company, it would be 25 miles. The total estimate for the two stations was £623,700.

In cross-examination, Witness said they had already had applications for a supply of current from colliery owners; at present the Northern Counties Company supplied power at Blyth at 2½d. per unit down to 1¼d. He certainly suggested that they would have a demand for 8,500 kw. The maximum prices to be charged by the Northumberland Electric Power Bill were 3d. and 1d., and those of the Newcastle Supply Company's Bill were 6d. and 2d.

A number of local witnesses were then called in support of the Bill, and gave evidence as to likely demands from colliery owners and others.

Rhondda Urban District Council Tramways.

A Select Committee of the House of Lords, presided over by Lord Elgin, commenced the consideration on Wednesday last week of the Bill of the Rhondda Urban District Council.

Mr. Balfour Browne, for the promoters, said the Bill was to authorise the U.D.C. to construct and work tramways amongst other things. Some years ago, 12 miles of tramways were authorised but the only portion constructed was from Pontypridd to Porth, which a short time ago passed into the hands of the British Electric Traction Company, which had greatly improved it. That company had tried more than once to get a footing in the district. The tramway from Pontypridd to Porth passed through the district of the Pontypridd local authority as well as the district of the promoters, and both had decided to purchase the line. The British Electric Traction Company had asked the Board of Trade to extend the time within which the local authorities could purchase, but the Board of Trade refused the request. The tramways, therefore, would pass into the hands of the local authorities next year. He hoped the Committee would say that the tramways should be constructed. There was no use in applying to Parliament for this purpose earlier, because until next year those tramways already existing would not pass into their hands. The benefit of the line would be very great. The streets along which the lines were to be laid were extremely narrow, and, apart from the tramways, so great was the traffic that widening and improvements in that district, costing £58,000, would shortly be carried out.

A number of local witnesses were then called to prove the necessity for further tramway facilities.

Mr. H. Morgan, chairman of the Pontypridd Urban District Council, said his Council welcomed the proposals, and were prepared to arrange a system of working with their own tramways. Sir Douglas Fox considered it a most promising scheme of tramways, and one which could be worked well from one generating station. The total length of the lines would be a little over 18 miles, and the cost per mile, including the construction of a new piece of road on which the line would be laid, would be £11,800 per mile, or a total of £222,268. Nearly £3,000 per mile of this was for widenings and improvements. Mr. Robt. Hammond, electrical engineer, who was engaged by the Rhondda Council in 1900 with reference to the electric light scheme, said he considered the district a most suitable one for electric tramways, and estimated the working expenses at 6·5d. per car-mile. Mr. J. Fell, contractor, of Westminster, stated that he had carefully examined the estimate and believed it amply sufficient. Evidence was then called in opposition to the scheme by the owners, lessees and occupiers of property. The evidence was to the effect that whilst the miners were in favour of the scheme, those who were considerable ratepayers were against it.

On Monday, Mr. Beasley, the general manager of the Taff Valley Railway Company was called in opposition to the Bill, and, after further evidence, the committee declared the preamble of the Bill proved, and ordered it to be reported to the House for third reading.

Standing Orders Committee.

The Standing Orders Committee have made the following recommendations with regard to Bills referred to them:—

London County Council (Subways and Tramways) Bill.—That Standing Order 129 be dispensed with in the case of the petition of the promoters of the Piccadilly and City Railway Bill.

Tyneside Tramways and Tramroads Bill.—That Standing Orders be dispensed with providing that tramways Nos. 4 and 9 be struck out of the Bill.

Halifax Corporation Bill.—That in the case of the Halifax Corporation Bill, the parties be permitted to introduce their additional provision if the Committee on the Bill think fit.

Hove, Worthing and District Tramways.—That Standing Orders be not dispensed with. This Bill, which accordingly drops this session, was one for empowering the Brighton and Shoreham Tramways Company to construct new tramways in lieu of existing tramways, and to work the same by electrical energy. There were also powers for the construction of a large number of new tramways, the scheme being of considerable magnitude.

On Monday Mr. Campion, one of the Examiners of Standing Orders, had before him the following Bills for proof of compliance with Standing Orders:—Whitechapel and Bow Railway (petition for additional provisions), Newcastle-on-Tyne Corporation Tramways Extension, Mexborough and Swinton Tramways, Hastings Tramways, Torquay and Paignton Tramways and the Birmingham and Midland Tramways. In the case of the Torquay and Paignton Tramways, the examination was postponed until March 17th, but in every case it was found that Standing Orders had not been complied with, and accordingly they will all have to go before the Standing Orders Committee, who will decide as to whether they shall be allowed to proceed.

Petitions.

The following petitions have been deposited against electric Bills:—The Oldham Corporation against the Saddleworth, Springhead and Lees Tramways Bill; the Great Western Railway against the Wrexham District Tramways; the Metropolitan Railway Company, the promoters of the Piccadilly and City Railway, the London County Council and the North Metropolitan Tramways Company against the Great Northern and Strand Railway Bill; the Woolwich Metropolitan Borough Council against the London County Council (Electric Supply) Bill; the Tyneside Tramways Company and the North-Eastern Railway against the Northumberland Electric Tramways; and the Kingston-upon-Hull Corporation against the National Telephone Company (Kingston-upon-Hull) Bill.

The London and North-Western Railway Company have withdrawn the petition against the Leicestershire and Warwickshire Electric Power Bill, and the Great Western Railway Company have withdrawn their petition against the Cornwall Electric Power Bill.

The conservators of the River Medway have withdrawn their opposition to the Kent Electric Power Bill; the Tyne Improvement Commissioners theirs to the Newcastle-on-Tyne Electric Supply Bill; and the Gloucester and Birmingham Navigation Company, and the Thornbury Rural District Council to the Gloucestershire Electric Power Bill.

Garston and District Tramways and Electric Supply (Transfer).—The General Committee on Railway and Canal Bills have reported that the Bill is unopposed, and have referred it to the chairman of the Committee on Ways and Means.

The House of Lords' Examiner on 6th inst. found Standing Orders proved in the case of the Rossendale Valley Tramways Bill.

Metropolitan District Railway Bill.—On 4th inst. an application was made by the Metropolitan District Railway Company to Mr. Campion, the Examiner, for the insertion of an additional provision in the company's Bill. By the proposed new provision the company seeks to secure additional lands, to authorise the application of moneys raised for the sale of superfluous lands, to the general purposes of the company's undertaking, and to confirm the award of the Board of Trade as to the system to be used in working by electrical power the undertaking of the company and the Metropolitan Railway Company. It was found that Standing Orders had not been complied with, and the matter was accordingly referred to the Standing Orders Committee.

LEGAL.

Brandt *v.* Johnson & Phillips.

This case came before Mr. Justice Kennedy in the King's Bench Division on Friday. It was an action by the plaintiff, Mr. Henry Adolph Brandt, to recover from the defendants the balance of an account he alleged to be due for the supply of mica goods to the defendants. Mr. Mouton Smith appeared as counsel for the plaintiff; and Mr. Groser for the defendants.

Mr. M. Smith, in opening the plaintiff's case, said that the goods in question were ordered by the defendants in this country from the plaintiff, who was the manufacturer of mica goods in Germany. The defendants counterclaimed against the plaintiff for damages. The shortest way would be to open the case with reference to each of the points raised in the defence. The claim on the writ was for £117 6s. 2d., balance of an account alleged to be due from

defendants. The defence said, first of all, that £60 15s., which was paid into Court, was all that defendants were liable for with reference to one lot of goods.

His Lordship: They say if you add our counterclaim to what we have paid into Court, it is enough.

Mr. M. Smith: On May 6th, 1901, the defendants, by letter, ordered from the plaintiff 398 mica segments to be built up in three pieces. The whole thing turned on what was meant by "built up in three pieces." That order was acknowledged by the plaintiff on May 8th, and he began deliveries. The first arrived at the defendants' works on May 28th. That was followed by other consignments down to June 22nd, when the last lot was delivered. During the period of the deliveries no complaint whatever was made by the defendants that the plaintiff had not manufactured the goods properly or understood their order correctly, but on July 1st the defendants wrote: "We are returning you to-morrow the mica segments, which are of no use to us, as they are now built up. There is an appreciable space where the ends of the pieces come." The next item in the defence was as to £2 4s. 6d. for micanite rings, and £10 for alleged faulty and defective construction of two micanite cylinders—£12 14s. 6d. in all. These were constructed by the defendants according to a design sent to the plaintiff by the defendants. These were ordered in January, 1900, and were returned in July on the ground that they would not stand a certain voltage. The defendants said they were not bound to pay £2 4s. 6d. for the micanite rings, because it was to remedy faulty work, and the defendants claimed £10 damages for the cost of putting copper rings on the flanges. The defendants alleged that the plaintiff gave an implied guarantee that the cylinders should stand a test of 80,000 volts. The defendants said on January 19th that great care would have to be used in the manufacture of the cylinders, as they would have to stand a test of 80,000 volts. The plaintiff's manager, Mr. Ward, went and saw the defendants, and said he could not guarantee any test at all. He explained that they were not electrical engineers, but simply makers of mica goods. Defendants then said that the cylinders need not stand a test of 80,000 volts, but 30,000 volts. The cylinders were sent in July, and the defendants afterwards complained that they had broken down. Mr. Groser said the fault of the cylinders was that they were made with a ½ in. flange. A very low voltage was applied to the cylinders and the electric current began to leak through at the joints, and the consequence was that instead of the ½ in. micanite flanges standing easily 45,000 volts, the current came through at the join. The last thing that the defendants claimed was the sum of £45 damages in respect of the non-delivery by the plaintiff of some micanite troughs within a reasonable time from the receipt of the order. These troughs were ordered on January 17th, 1900. The order was for 1,080 troughs. On March 6th the defendants wrote to the plaintiff to keep the troughs in abeyance until he heard further from them. On March 12th the plaintiff wrote that 150 had already been made, and these were delivered in April. On March 15th the defendants wrote that the troughs must be 2 in. longer, but all other dimensions must remain the same.

Mr. Groser: My contention is that the contract was to supply these troughs within a reasonable time. As a matter of fact, we did not get the last of the goods until October, which we say was an utterly unreasonable time, and that we were in consequence put to damage and loss.

Mr. Ward, the manager of the plaintiff, gave evidence, generally bearing out the statement of counsel.

During the course of this witness's evidence it was arranged that the plaintiff should take back the mica segments and give up their claim with regard to those.

Mr. Groser said that he would call his evidence before addressing his Lordship for the defendants.

Mr. Wm. B. Esson, manager of the defendants' firm, said that if properly made, and if the flanges had been properly attached, the cylinders would have stood a pressure of 40,000 volts. There had been a leakage through the joints of the flange, and sparks had passed. It was not the case that there was a hole through the cylinders. The joint was not properly made, and the flange was not properly cemented to the barrel. The plaintiff remedied the thing by putting on angular rings. The one escape was sufficient to render useless the whole of the cylinders. His firm had accepted work under penalties for which the troughs were required.

Mr. H. J. Shepherd, accountant to the defendants, gave evidence as to the sums paid by the defendants to workmen and others for overtime wages in order to get the defendants' job done expeditiously, which sums the defendants claimed to recover from the plaintiff.

Mr. Duncan Keogh, an electrician employed, gave evidence that, in his opinion, the leakage of the electrical force in the cylinders was caused through insufficient insulation between the barrel and the flange.

Mr. Wm. Jas. Muir, foreman of the electrical engineers' shop of the defendants, examined by Mr. Groser, said that when the wire was taken off the transformer he made an examination, with the object of finding out where it was faulty. The leakage was between the flange and the barrel. In his opinion the flanges were not properly attached to the cylinder. That would be the fault of the makers.

The learned counsel on both sides having briefly addressed his Lordship, his Lordship, in giving judgment, said that the case would probably have taken some days to try if it had been referred to an official referee. He was of opinion that, on the first head of claim, the defendants' contention succeeded, as he had already indicated. It appeared to him that the mica segments were not made as they should have been, and under these circumstances he thought that the charge for these could not be made out by the plaintiff. The segments which remained warehoused by the defendants must be returned to the plaintiff. Then came the question of the cylinders. With regard to them, he should give judgment for the plaintiff for the following reasons:—They were made to a design which had not been tested before. The only fault which was detected, and which led to the strengthening of the parts by the supports or rings, was that the electricity passed in some way between one of the flanges and the body of the cylinder. It was suggested by the defendants that that showed there was a weakness in the connection between the cylinder and the flange. He did not think that the defendants had made out that it was owing to a flaw in the joint or to bad workmanship that the mischief happened. It might be that this, which was a novel design, was essentially weak as a design. It was said that much greater voltage ought to be safely applied. There was no contract by the plaintiff for any particular voltage at all. It did not appear to his Lordship that the defect arose through any fault of workmanship. He thought on the question as to the delay in the troughs that there had been some unreasonable delay by the plaintiff. He thought, however, that the defendants' claim on this head had been greatly exaggerated. For this he should allow the defendants to deduct £10 from the plaintiff's claim. In the result his Lordship entered judgment for plaintiff on the claim for £47 4s. 6d. beyond the amount paid into Court by the defendants, the plaintiff to have the general costs of the action. The defendants to have their costs on the counterclaim.

London County Council *v.* Metropolitan Electric Supply Co.

In the House of Lords on 10th inst., an appeal was heard in this case which came before the Court of Appeal in May last year, on which occasion the decision of Mr. Justice Farwell was reversed. There is no need for us to cover the ground of the case again, the first hearing, and the appeal, having been already reported in our columns (see Electrical Review, May 3rd and 17th, 1901). Their Lordships last week allowed the appeal, and restored the judgment of Mr. Justice Farwell. The appeal was heard by the Lord Chancellor, Lord Macnaghten, Lord Shand, Lord Davey, Lord Brampton, Lord Robertson, and Lord Lindley.

The Sir Hiram Maxim Lamp Co. *v.* The Sir Hiram Maxim Electrical Engineering Co.

In the Chancery Division (Friday) before Mr. Justice Swinfen Eady, Mr. Eve, K.C., moved, on behalf of the defendants, that all proceedings in the action might be stayed in order that all differences or disputes between the two companies might be referred to arbitration pursuant to an agreement. Learned counsel stated that the defendant company were the manufacturers of certain electrical lamps, and Mr. Downey, who was interested in the matter, came to the conclusion that it would be desirable to form a subsidiary company in order to acquire from the parent company the right to manufacture and dispose of these lamps in the United Kingdom. Accordingly an agreement was entered into which gave him for a certain period an option of acquiring these rights with a view to the ultimate promotion of a company who would take over those rights from him.

Mr. Justice Eady: What is the point between you?

Mr. Eve said the suggestion seemed to be that the agreement was not a binding one, and that the contract ought to be rescinded by reason of mutual breaches. Downey having obtained this option he was required to deposit £5,000 as security for the due performance of the agreement This he had done, and it was held by the defendant company. The plaintiff company was also formed, and the action which had been begun by them claimed a rescission of the agreement, an injunction to restrain the defendants from dealing with the £5,000 deposited by Downey; also from dealing with some 20,000 fully paid shares, and claiming damages. There was a question as to the quality of the lamps which had been supplied. He submitted that under the clause in the agreement the matters in dispute ought to go to arbitration.

Mr. Justice Eady said he did not see why that part of the action which asked for damages should not be stayed, whilst the action asking for rescission should be allowed to go on. On the other hand, the plaintiffs might amend their statement of claims by striking out their clause for damages.

Mr. Macnaghten, K.C., for the plaintiffs, said he would do that on the understanding that the arbitration should not be proceeded with until the action as to rescission had been disposed of.

Mr. Justice Eady thought the action for rescission ought to be tried first.

Mr. Eve agreed.

Mr. Macnaghten then moved a cross motion on behalf of the plaintiffs, seeking to restrain the defendants from dealing with the £5,000 and the shares until the trial of the action.

Mr. Eve said his clients had no intention of dealing with them, but he was willing to give an undertaking.

Mr. Justice Eady said on that undertaking he would make no order on the motion.

Dolby & Williamson *v.* Lord Wenlock.

This case came before Mr. Justice Wright in the King's Bench Division on Tuesday. Mr. McCall, K.C., and Mr. B. A. Cohen appeared for plaintiffs; and Mr. Lawson Walton, K.C., and Mr. Bairstow for the defendant.

It appeared that the plaintiffs, who are electrical engineers, claimed £318 for professional charges in connection with the installation of electric light at Lord Wenlock's seat, Escric Park, York. The defendant had paid £150 into Court with a denial of liability. The case turned on the correspondence between Mr. Walker, agent of the defendant, and the plaintiffs as to the amount

for which the work was to be done. Mr. Lawson Walton submitted that the work was to be executed for £3,000. The work occupied from October, 1900, to June, 1901, and Mr. McCall contended that on the letters between the parties, if there was a limit to £3,000, it applied only to the year 1901, the instructions being that the plaintiffs were to prepare a scheme which would be capable of development, and on which there would be much larger expenditure than £3,000 in the year 1901. In the communications which passed, various alternative tenders were submitted to the agent, who decided that the highest was too expensive and the lowest unworkable. Suggestions were made by which portions of the scheme should be omitted, and on this part of the case, Mr. Walton put it that the letters showed that even with these reductions on a higher tender, the work was not to cost more than £3,000.

His LORDSHIP pointed out that the plaintiffs had charged 3 per cent. on a scheme which was to cost about £5,000, as well as 3 per cent. on a smaller scheme. Could they charge 3 per cent. on both schemes?

Mr. MCCALL contended that the plaintiffs were within their rights in doing so, as they had received instructions to prepare both schemes. The expert evidence would show that this was the ordinary practice of the profession, and added that the plaintiffs had written to Mr. Walker that he could not expect them to go to the trouble of preparing a scheme and inviting tenders, without compensating them for their trouble. In a further letter the plaintiffs had pointed out that it was unreasonable to expect the same results for £3,000 as could have been obtained from an original estimate amounting to almost twice that sum.

Mr. WALTON suggested that an answer to an application by plaintiffs for a payment on account of fees, should be read.

Mr. MCCALL read the reply of Mr. Walker, which was to the effect that he would not pay any fees, because he considered that the plaintiffs' charges were exorbitant, and that Lord Wenlock was entitled to damages, because of the inferior work which had been done.

Mr. E. R. DOLBY, one of the plaintiffs, gave evidence of interviews he had with Mr. Walker as to the installation, and stated that he was told the defendant did not want to spend more than £3,000 in the first year, and subsequent work was left open for future consideration.

Mr. Walker, in a letter dated March 27th, 1901, had agreed to spend £3,260 in the first year, and the tender submitted was for £3,040. That was a workable scheme, the lower figure having been arrived at by reducing the size of the battery. The 3 per cent. was charged on the smaller scheme, as well as on the original one, because plaintiffs had to prepare fresh drawings, and arrange the plant in a different manner. Mr. Walker never said there was a limit of £3,000, and plaintiffs were only to be paid on that. Plaintiffs prepared a scheme of which sections could have been carried out for £3,000, but Mr. Walker put in other sections which raised the cost. The work which had been carried out by others was according to the plans prepared by plaintiffs.

Mr. WALTON said he did not dispute that the scheme which had been carried out was workable, but what he did suggest was that the plaintiffs had prepared a scheme which was not workable, and for which they charged their fees.

Mr. DOLBY, continuing, said the charges of the plaintiffs were fair and reasonable, and according to the usual practice. In cross-examination, he claimed that an electrical engineer was entitled to be paid scale fees even if the scheme was not approved.

Mr. BURSTALL, electrical engineer, said the charges made by the plaintiffs were usual in the profession. Cross-examined, the witness said, generally speaking, he agreed that the estimate should be carried out for within 20 per cent. of the figure quoted before the engineer could be considered as entitled to his fees.

Mr. WALTON, for the defence, said that the defendant was anxious that the plaintiffs should be paid something, and he considered the sum paid into Court ample payment for the services the plaintiffs had rendered. The limit of £3,000 had been fixed upon, but plaintiffs had submitted a scheme costing far more than that sum, and the £150 was paid into Court in respect of such portion of their services as had proved useful to the defendant.

Mr. FRANCIS ELLIOT WALKER, the defendant's agent, gave evidence to the effect that, from the beginning to the end, the limit of £3,000 was insisted upon. A tender was obtained for £3,800, but witness refused it, and he put an end to the matter. The plaintiffs then sent in a mutilated scheme for £3,044. Had he been aware that the plaintiffs' estimate might be exceeded by above 20 per cent., he would not have agreed to it. He was limited by Lord Wenlock to £3,000.

Mr. E. A. GRUNING, architect, said that in a case where the design sent in was more costly than the estimate, the range allowable was within 10 per cent. of that estimate before the architect could claim his 3 per cent. That was the custom of his profession, though it was not the law.

His LORDSHIP asked whether there was any objection to payment by *quantum meruit*.

Mr. MCCALL said he was quite ready to take six guineas a day.

Mr. WATNEY, electrical and consulting engineer, said if an estimate was made, it should be carried out at a figure within about 10 per cent. of it.

Mr. WALTON submitted that all the plans had been obviously experimental, and taking the seven days during which Mr. Dolby was occupied at six guineas a day, together with incidental work in London, that would give a sum of about £50. Three times that amount had already been paid into Court, and considering that, strictly speaking, Mr. Dolby was entitled to nothing, his estimate having been exceeded, he had been very fairly dealt with.

His LORDSHIP, in giving judgment, said it was pretty clear that there was no rule as to charging 3 per cent. on either the tender or anything else, nor was there any custom proved as to the margin that could reasonably exist as between the estimate of the electrical engineer and the tender by which he was able to get the work done. The questions were whether the plaintiffs were entitled to anything at all, or whether they were to be paid by *quantum meruit*. On the whole, he came to the conclusion that the sum paid into Court was sufficient to meet the claim; but as it had been paid in with a denial of liability, judgment would be for the plaintiffs, with costs, down to the time of such payment into Court. No order was made as to the costs in Court.

CORRESPONDENCE.

Economy of Isolated Plants.

In answer to Mr. Dumaresq's explanation of the 7th inst., I regret that a request for further information in regard to figures which he has kindly published, could not be dealt with in a tone more suitable to the discussion in a technical journal of a matter in which many readers are interested.

That my request was not unnecessary is evident from the fact that his reply entails considerable modifications and additions to the particulars given in his first letter.

I note that he does not propose to go further in the matter, though there are several items which would admit of further explanation. The point under discussion is "The Economy of Isolated Plants," where there is a possibility of public supply in competition therewith.

It seems evident that "economy" cannot be said to occur in a commercial sense, if capital be employed at a less rate of revenue thereon than could be obtained if the capital were employed in the capitalist's own business, in the case in question, a large general stores.

If, therefore, the capital employed in an "isolated plant" would produce a higher revenue if otherwise employed, it is a loss, and not a profit, to lock it up in "isolated plant."

Does any successful business reckon 5 per cent. per annum net revenue on capital a satisfactory return? Would capital be invested for at least a 10-years' term on this basis of return in competition, where the competitor probably drops the price every year, and the margin of profit over 5 per cent. is at the commencement of the 10-year period slight or non-existent, while probably long before the 10-year term has expired it is a minus quantity?

I do not propose to repeat Mr. Dumaresq's costs for 1900. The works costs will, I think, be found to be 2·17d. per unit; charging 5 per cent. on the capital then employed, a redemption fund to recover same in 10 years at 5 per cent., and allowing £36 for insurances and office expenses, the total costs for that year amount to 3·08d. per unit; the public supply could have been obtained at 4·8d. per unit, a saving that year of 1·72d. per unit.

For 1901, with the increased capital, and an estimated load of 175,000 units, allowing £61 10s. for insurances and office expenses, the total cost will be 3·45d. per unit, and the supply could have been obtained at 3·33d. per unit, a loss of 0·12d. per unit.

For the purposes of comparison, I do not admit the items for renewals, wages, rent, as correctly stated, and think these should be increased.

The conclusion to be drawn is that, within two years, the "isolated plant" is probably a source of loss; if the capital sunk therein could be employed to bring in more than 5 per cent. it is certainly so, and this loss will increase, and not diminish.

H. Moul.

Electric Inspectors.

The Electric Lighting Order for a district where the undertakers are a limited company reads: "The local authority, so long as they are not themselves the undertakers for the purposes of this order, may appoint, and keep appointed, one or more competent and impartial person or persons to be electric inspectors under this order."

Can any readers of the ELECTRICAL REVIEW kindly state a place where such inspector or inspectors is already appointed, and the usual terms, &c., under which such inspectors are remunerated?

Thorne.

C.—9,247.

There were two misprints in my long letter which appeared under the above heading in your last issue. In the third line, *for* 52 *read* 25; and on page 378 *for* the hale Captain, *read* the late Captain.

My last sentence has been mis-read. In writing "I stipulated for a period of three years to allow me time to experiment," I meant three years between the signing of the contract and the completion of the laying. I had originally written *délai*, and did not perceive that I introduced some ambiguity when I substituted the word "period." Several of your readers have thought I meant three years for experiments alone.

W. Sharpey Seaton.

The Testing and Management of Electric Motors.

At the moment of writing I have not the issue containing Mr. Poole's letter before me. As I look upon the matter, so far as Mr. Poole is concerned, am I to assume that motor losses, as set forth in the article of November 8th, remain constant from no load to full load? Mr. Cramp, so far as my recollection goes, rather forcibly commented upon Mr. Poole's article, and it may be that they are *not* in accord. If they are in accord, the formulæ for what Mr. Cramp terms the "armature efficiency" represent practically also the motor efficiency. I was rather unfortunate in the wording of the hint, but I do not think a dozen of your readers actually misunderstood me. No sane person would for an instant imagine that a motor reaches its highest possible efficiency when it is doing nothing, or is, in other words, simply running without a load. I have known motors to show an efficiency of 88 per cent. at or near full load, and I have known others to show something about one half. In no case will a motor show a high efficiency when its rated load is exceeded to any great extent. That is what is meant by "an increase of load."

Will Mr. Poole say what it is that is represented by the figure "4" in his equation, and without writing round the question, also say in plain language that a motor will *not* run faster if the field excitation is decreased, or that motor brushes *cannot* be raised while the machine is at work? Then I may be able to reply to him, though I cannot hope to emulate the happy and decidedly witty way he has of putting things. It all comes, no doubt, through close acquaintance with the "new humour."

P. T. White.

Distribution Cables for Three-Phase Working.

Referring to the article in your issue of January 10th, upon "Distribution Cables for Three-phase Working," and to my letter of January 24th asking for information as to the method of jointing claimed in the original article, I must mildly express my surprise that the information is not yet available.

This is the more remarkable when one considers the emphasis laid on this feature in the original article, and considering the great advantages which such a method of jointing possesses, it seems strange that neither the writer of the article nor the makers of the cable should deem the point worthy of being demonstrated.

The issue is a plain one, either the jointing can be practically done as described, or it cannot: in the former case there should be no valid reason for keeping the method secret if business is intended to be done, and in the latter case the claim should be at once withdrawn.

M. R.

[No doubt if our correspondent will address the inventor direct on the above matter he will get all the information he requires, and this we should advise him to do.—Eds. Elec. Rev.]

Localising Faults.

In reply to "Station Engineer," I should be very pleased if I could tell him how to localise a fault on a long length of cable with an ohmmeter "within a yard or two," but I think you could get as near to the fault with the ohmmeter as you could by running up an alternator for every test, and the ohmmeter is by far the most convenient instrument of the two when time is important. I quite agree with him that there are faults that will test all right and break down directly working pressure or less is switched on; but surely, this particular fault did not test so, 2,000 ohms to earth or less is what one would most likely get on a burnt and wet hole in paper concentric, such as the one described. I should certainly have thought that to have removed earth connections and treated the fault as an earth would be much quicker than the bother of getting off the transformers, and running up the alternator for each test. The time taken to clear the main does seem excessive.

Mains.

Accumulators and Electric Traction Systems.

My attention has been called to the questions raised by Mr. H. W. Dix. The curves related to a plant operating 25 cars, the generators were shunt wound, and the bus bar voltage was an exceedingly close approximation to constant pressure. The booster was manufactured by the Electric Construction Company, Limited.

E. S. W. Moore.

Wolverhampton,
March 7th, 1902.

Information Wanted.

Can you, or any of your readers, inform the writer through the columns of the Electrical Review of any firm who would supply a jig for filing dynamo brushes to the correct bevel?

R. E.

"Bective" asks for the name and address of the makers of celluloid balls suitable for illuminating purposes.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Mar. 12th, 1901.	Value £
Adelaide	445
Amsterdam	612
Antwerp	21
,, Teleph. mat.	130
Auckland	95
Bombay	40
Brisbane. Teleg. mat.	24
Buenos Ayres. Teleg. cable, &c.	319
Calcutta	2,286
Cape Town	1,009
,, Teleg. mat.	14,449
Colombo	212
,, Teleg. mat.	18
Durban	191
East London	31
Hamburg. Teleg. mat.	200
Havre	190
Hong Kong	10
Liban	20
Melbourne	3,526
Port Chalmers	105
Port Elizabeth	86
Shanghai	148
Sydney	1,648
Tientsin	21
Vera Cruz	51
Wellington	1,144
Yokohama	573
Total	£27,604

Week ending Mar. 11th, 1902.	Value £
Alexandria	107
,, Teleph. mat.	80
Amsterdam	125
Auckland. Teleg. mat.	1,330
Bombay	38
Bremen	75
Buenos Ayres. Teleg. mat.	62
Calcutta	1,361
,, Teleg. wire	373
Cape Town	2,256
Colombo. Teleg. mat.	286
Copenhagen. Teleg. wire	13
Durban	673
East London	30
Fremantle	271
Halifax. Teleg. wire	25
Hamburg	603
Hiogo	67
Hobart	22
Hong Kong	21
Ostend	30
Perth	650
Port Elizabeth	624
Rangoon. Teleph. apprts.	420
Reval	141
Rotterdam. Teleg. mat.	98
St. Petersburg. Teleg. mat.	120
Singapore	167
Stockholm. Teleg. wire	60
Suez. Teleg. insts.	1,496
,, Teleg. mat.	124
Sydney	248
Wellington	585
,, Teleph. mat.	1,389
Total	£13,911

Foreign Goods Transhipped.

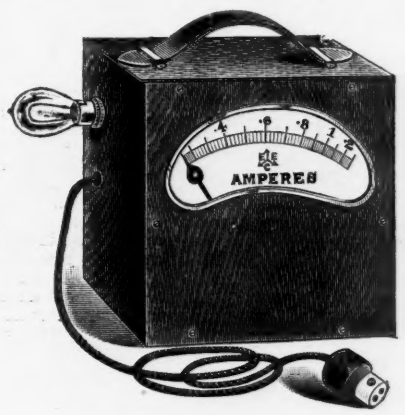
	Value £
Gothenburg. Teleph. apprts.	39
Madras. Elec. cars	170
Sydney. Elec. mat.	106
Trinidad. Elec. goods	38
Total	£353

Directory.—Messrs. Hazell, Watson & Viney have just issued from the press their "Electric Lighting and Traction Directory for 1902." The book is edited by Mr. C. S. Vesey-Brown, and gives much information of a very serviceable nature relating to the engineering equipments of the various stations, together with particulars as to working costs, receipts, &c. Details of the many undertakings (electric lighting, tramways, railways, and so forth), which are at the moment awaiting the consideration of Parliamentary committees are included, the publication of the work having been delayed in order that this might be so. The price of the directory is 6s., and it is handsomely got up, and we should think that those who are not already provided with such a collection of electrical statistics would find it well worth the money.

The Dusseldorf Exhibition.—We have received a small booklet relating to the forthcoming exhibition at Dusseldorf, to which reference was made in a recent issue. We learn that the exhibition authorities are represented in this country by the Gordon's Advertising Agency, 1, Duncannon Street, W.C. As we have already stated, the exhibition will be largely devoted to the Engineering and Electrical Industries, of which Dusseldorf is the chief centre in Germany. The Exhibition opens on May 1st and closes on October 20th. We have no doubt that anyone who is interested in the matter can obtain a copy of this interesting little booklet by applying to Messrs. Gordon's Agency.

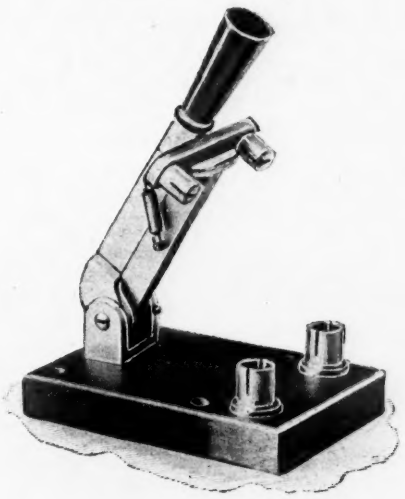
Electric Light and Power at a Drapery Warehouse.—A large installation, consisting of electric lifts, pumps, fans, incandescent and arc lighting, has just been completed at the new premises of Messrs. Jeremiah Rotherham & Co., Limited, 79—91, Shoreditch, N.E., the current being taken from the mains of the Shoreditch Corporation at a pressure of 150 volts. The power service mains are kept separate from the lighting service mains, and after passing through the Corporation fuses and meters, are connected to two main switch and fuse distribution boards for power and lighting respectively. The power service board is arranged for five circuits supplying three electric lifts, one electric pump, and one sub distribution board controlling the 16 fans throughout the building. Each main circuit is controlled from a d.p. quick-break switch and d.p. fuse, and on the power service board is mounted an Evershed dead-beat ampere-gauge, and volt-gauge. The three electric lifts, one of which is for passengers, and two for goods, are of Messrs. R. Waygood & Co.'s latest type. They consist generally of a worm gear running in oil, directly connected to an enclosed motor running at about 600 revolutions per minute. The worm gear is directly keyed on to the drum which winds up the hoisting ropes, giving a speed, in the case of the passenger lift, of 160 ft. per minute, and in the case of the goods lifts, 100 ft. per minute. The motor-controlling switch is fitted with a device to prevent the operator cutting out the resistance too quickly, and automatic overload and no-voltage circuit breakers are also provided. A further safety device is fitted so that if for any reason the distance between car and counterweight be varied, or should the rope slacken or break, a switch immediately opens cutting off the supply of current to the motor, and should this fail to stop the car, it is immediately afterwards brought to a standstill mechanically by means of safety jaws brought into action upon the sides of the runner backings. The electric pump was installed by the General Electric Company (1900), Limited, and consists of a 2-H.P. shunt wound motor running at 1,000 revolutions per minute driving, by means of a belt, a three-throw pump capable of pumping 1,140 gallons of water per hour against a head of 16 ft. The pump runs at a speed of 45 revolutions per minute, and is geared down from the belt-driven pulley by a machine-cut spur wheel and pinion. A complete duplicate set is provided, together with a d.p. change-over switch, so that, should one set get out of order, the other can be started immediately. The starting and stopping of the pump is automatically controlled by means of a copper float in the tanks, which puts a quick-acting d.p. switch on or off as the tanks are empty or full, by means of a lever. This switch controls a G.E.C. patent solenoid motor-starter in the pump room. The electric fans are of the well-known Blackman type. The lighting service board is divided into three portions, for arc lighting, incandescent lighting, and house service respectively, the latter being metered separately from the rest. These circuits are further sub-divided by means of switch and fuse distribution boards, of which there are two on every floor, from which the sub-circuits are run to supply the various arc and incandescent lamps. The maximum number of incandescent lamps supplied by any sub-circuit is eight, and each sub-circuit is controlled by a d.p. bridge type fuse and s.p. tumbler switch. With few exceptions, every lamp is furnished with a separate switch, and in large rooms the switches are grouped together on boards at convenient points. The arc lamps are of the Gilbert open, single carbon type, capable of running for about 1 hours without requiring re-trimming. They are of 5-ampere size, and are arranged in groups of three in series for 150 volts. Each lamp is fitted with a substitutional resistance for series running. The total number of lamps installed in the new premises is about 850 incandescent and 36 arc lamps. The electrical installation was designed and superintended by Mr. Reginald J. Wallis-Jones, of Messrs. Wallis-Jones & Dent, 36, Great George Street, Westminster, in his capacity of consulting engineer, and the contractors for the work were Messrs. Simpson Bros., of Hapton, near Burnley, who also made and supplied the whole of the switch and fuse distribution boards.

A New Lamp Tester.—The accompanying illustration shows an ingenious device for rapidly finding the amperage of glow lamps. The usefulness of a glow lamp depends upon two things—firstly, whether it is giving light enough, and secondly, whether it is taking too much current for that light. The first question is roughly answered by an inspection of the area lighted. To determine the power consumed, however, has hitherto been a matter of considerable difficulty, entailing, as it usually did, either the making up of special connections for the insertion of an ammeter, or the removal of the lamp to a specially arranged testing bench. By means of the instrument illustrated, however (which, it should be mentioned, is manufactured by Messrs. Everett, Edgcumbe & Co., of London), all that is necessary is to remove the lamp from its holder and place it in the one fixed to the instrument (seen on the left of our illustration). On inserting in its place the adapter attached to the flexible cord, the pointer will at once indicate the exact current taken by the lamp at the supply voltage upon which it is being run. A useful table is provided with the instrument, from which the efficiency of any lamp in watts per *nominal* candle-power can be at once found from a knowledge of the approximate supply voltage, and a reading taken on the lamp tester. Another use to which this instrument can be put is to show approximately whether a lamp of unknown candle-power is, say, an 8, 16, or 32, a question which is often difficult



to determine by mere inspection. It may be added that these instruments are similar as regards internal construction to Messrs. Everett, Edgcumbe's now well-known "Universal" instruments, so that they can be used upon either direct or alternating circuits with equal accuracy. They are spring controlled and extremely portable. These lamp testers should prove especially useful in hotels and public buildings, where the means which they afford of keeping a check upon the condition of the lights, both before being put on circuit and after running for some time, may effect a considerable saving in the electric lighting bill.

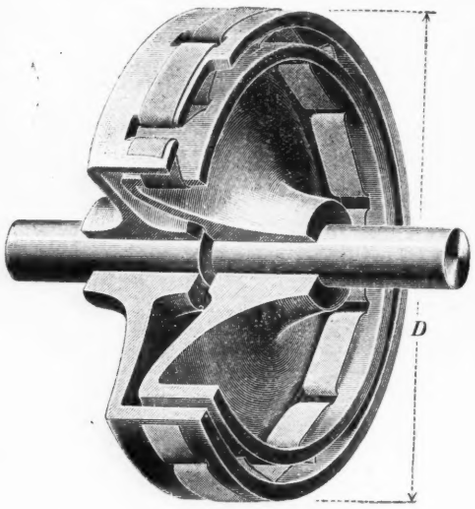
Quick-Break Switch.—We illustrate herewith a neat form of double-break switch, patented by Messrs. Broadbent and Brooke, and made by Mr. T. W. Broadbent, of Huddersfield, in sizes from 50 to 500 amperes. The special feature is the good contact, which, it is claimed, is secured by the split plugs and sockets.



The former are slightly tapered, to cause the sockets to expand and grip the plugs. In case of injury to the working parts by breaking an excessive current, they can be renewed in less than two minutes. Single and double-pole, and change-over switches are also made in this form.

Zodel's Patent Flexible Coupling.—The accompanying illustration shows a useful contrivance for connecting a dynamo directly with the crankshaft of an engine or with a turbine shaft. It is often not possible, especially with large dynamos, to erect them on one common foundation plate with an engine or other prime mover, and where it cannot be done the difficulty that has to be met is to bring the shafts of the two machines exactly into line. But even when this is achieved there is some chance that one of the foundations may yield, or that, owing to the uneven wear of the bearings, the shafts get out of line, and great trouble is the result. This coupling, the invention of Mr. Louis Zodel, the chief engineer of the turbine department of Messrs. Escher, Wyss & Co., of Zurich, prevents all such difficulties and is extremely simple and reliable. It consists of two discs, with rims containing slots through which a

leather or cotton band is drawn, connecting the discs, which are fixed on the ends of the shafts to be coupled. An elastic connection between the two machines is thereby established, which prevents all strain on any bearings if the shafts are out of line. At the same time the leather or cotton band serves as an insulator. The wear



and tear of the bands is extremely small, and should it ever become necessary to renew it, a leather band of the necessary size can easily be obtained anywhere. India-rubber, which is sometimes used in couplings for the same purpose, is not so easily obtained, and besides, it becomes brittle in time and requires to be replaced more frequently. The inventor has also designed a clutch on the same principle, which allows the dynamo to be connected or disconnected with an engine or turbine; this operation must, however, be performed while the machines are standing still. These couplings are most extensively used on the Continent for all powers, the diameter D depending upon the power to be transmitted. At one place there are seven such couplings in use for units of 2,200 H.P. Electrical engineering firms are using them generally, and several electrical stations in this country have already adopted them. At Frongoch Mines, Devil's Bridge, Cardiganshire, one is used to connect a three-phase generator of the Electrical Company, Limited, with an Escher, Wyss & Co. patent Pelton turbine of 400 H.P., and a Willans engine. At Trefriew, North Wales, a similar coupling connects a Sandycroft dynamo with an Escher, Wyss & Co. turbine of 50 H.P., and they are in use in other places. The sole agent for these couplings and clutches is Mr. Alph. Steiger, M.I.C.E., of 28, Victoria Street, Westminster, S.W., who is Messrs. Escher, Wyss and Co.'s representative for the British Empire.

Bankruptcy Proceedings.—A receiving order was made last week at the London Bankruptcy Court against John Hervey Redgrave, described as an electrical engineer, lately carrying on business at 53, Regent House, Regent Street, W., and residing at Gloucester Road, New Barnet, present address unknown. Messrs. Burgess & Co. made the application on behalf of the petitioning creditor. The act of bankruptcy cited in the petition was the departure of the debtor with intent to defeat and delay his creditors. It is understood that a warrant has been issued against the debtor on a charge of obtaining money by fraud, it being alleged that he had raised over £50,000 by mortgage over a mortgage on the same properties owned by him at High Barnet. He managed to elude arrest on February 16th, since which time the police have been searching for him, but up to the present without result.

First meeting of creditors will be held at Bankruptcy Buildings, Carey Street, on March 17th; and the date of public examination is April 11th, at the same place.

A meeting of creditors was held at Birmingham on 5th inst., in the case of J. W. Westwood, electrical engineer. The liabilities amounted to £218, and the assets are expected to realise £36.

At a sitting of the London Bankruptcy Court, held on Thursday, 6th inst., before Mr. Registrar Hope, Jacob Gutmann, agent for the sale on commission of electrical and other fittings, Graham Road, Hackney, attended for public examination upon accounts showing a liability of £420 to the petitioning creditors (Messrs. Markt Bros. & Co., Beech Street, Barbican), and assets, "book debts £187 10s.," treated as irrecoverable. A previous failure is recorded against the debtor in September, 1898, when he was trading as a dealer in electrical fittings at 48, Commercial Road, E., under the style of J. Goodman and Co. He subsequently took up several agencies, and in 1900 had an office at 40, Danbury Street, Islington. During November of that year he entered into an agreement with the petitioners for the sale of their goods on commission terms, but after three months the goods were invoiced to him in the ordinary way. The failure was attributed to losses in the agency business and on the trading generally. Upon the case being called, Mr. G. W. Chapman, official receiver, reported that he did not anticipate that the debtor would attend. He was an undischarged bankrupt under the former failure, and when served with the notice of this examination, he had said that he was not going to attend to it. The learned Registrar, adjourning the examination *sine die*, with leave to the Official Receiver to make an application in Chambers for a warrant with a view to securing the debtor's attendance.

At a sitting of the London Bankruptcy Court, held last Wednesday before Mr. Registrar Giffard, Frederick Herbert Berry, lately an electrical engineer and electric wire manufacturer, but more recently a licensed victualler, applied to pass his public examination upon accounts showing total liabilities, £17,849 8s. (unsecured £4,639 19s. 8d.) and assets *nil*. In the course of his evidence the debtor stated that he carried on business as an electrical engineer and electric wire manufacturer for many years prior to March, 1896, when he transferred the business, then being carried on at 14A, Clerkenwell Green, E.C., to a company which was formed with a capital of £6,000 to acquire it. The sale consideration was £6,000, payable as to £3,000 in 5 per cent. debentures and £3,000 in ordinary shares of the company. He transferred a large portion of the shares and debentures to his wife in March, 1901, in consideration of a small sum then paid, and in satisfaction of moneys previously advanced to him. Since the conversion he had acted as managing director of the company, at a salary of £200 a year, but owing to the small amount of business done for some time past, his salary had not been paid. In 1897, with £500 capital, he commenced speculating in public houses, and made profits on several houses, which he contracted to buy, but resold before completion. He had also carried on several public houses, and he attributed his insolvency to loss in the trading thereat, to law costs, and to depreciation in the value of the various mortgaged properties. The examination was ordered to be concluded.

Under the failure of George Willie Clarke, electrical engineer, late of Harold Wood, near Romford, and 117, Queen Victoria Street, E.C., the debtor attended before Mr. Registrar Giffard, last Wednesday week, for public examination upon accounts showing total liabilities £5,269 17s. 1d. (unsecured £3,373 5s. 2d.); assets £544 1s. 6d., subject to preferential claims of £129 11s. 11d., and a deficiency estimated at £2,958 15s. 7d. Mr. E. L. Hough, senior official receiver, conducted the examination, and Mr. F. Cooper Willis represented the trustee, Mr. A. F. Lovell. Questioned by Mr. Hough, the debtor stated that prior to 1893 he was in the employ of a firm of electrical engineers, but in that year he took over the East Hanningfield Mills, near Chelmsford, where his father had carried on the business of a corn merchant and miller. Owing to the cost of extensive alterations, he had to mortgage the property, and in March, 1891, in consequence of the mortgagee having required repayment of the principal due on his mortgage, he closed the mills and handed to the mortgagee the stock and the bulk of the plant and effects. During 1900 he commenced business as an electrical engineer and contractor at his residence at Harold Wood, and in August, 1901, he opened a shop at 15, High Street, Grays. The shop, however, did not pay, and was closed in November last. Two months before closing the Grays branch, witness opened an office and showroom at 117, Queen Victoria Street, where he also carried on business until December 23rd, when he executed a deed of assignment for the benefit of his creditors. He mainly attributed his failure and insolvency to loss at the East Hanningford Mills; also to law costs, interest on loans, and depreciation in the value of the electrical stock, plant, and utensils as estimated for a forced realisation. It was the fact that he had been pressed by creditors during the last 12 months, and that a number of judgments were obtained against him during that period. He knew that he was insolvent, but hoped to pull through by means of the Victoria Street business. In June last, and subsequently, he pledged electrical goods with Messrs. Huddleston & Co., a firm of electrical engineers and auctioneers, who offered through the columns of the ELECTRICAL REVIEW to render assistance to persons in financial difficulties. Witness could not state off-hand how many pledges had been given, but a record of them appeared in his books of account. Some of the hypothecated goods were purchased on credit, and had not been paid for. Witness would swear that he did not purchase a cable in order to pawn it. He agreed that it was larger than he required for the purposes of his business, but he was induced to buy it because it was offered on cheap terms by taking a large quantity. The prime cost of the cable now held by Messrs. Huddleston & Co. was about £100, and they held other goods to a similar value. To the best of his belief one-half of the goods now in the hands of that firm were obtained on credit and had not been paid for. Asked with regard to five cheques, amounting in all to £123 0s. 8d., given to the General Electric Company on November 15th, 16th, 17th, 18th and 19th last, the debtor stated that they were in payment of goods purchased by him on those dates for stock at the showroom in Queen Victoria Street. The cheques were not honoured by the bank. He had been allowed an overdraft, but occasionally received a scolding from the manager when his debit ran too high. Mr. Allwood, the General Electric Company's accountant, was aware of that overdraft, and when that gentleman interviewed witness respecting the five dishonoured cheques, he (debtor) gave him an authority to the amount of £150 on a debt due from the London and India Dock Company. That authority was withdrawn when witness executed the deed of assignment in December last. During the three months preceding that deed witness spent between £600 and £700 with the General Electric Company, and with the exception of the five cheques before mentioned, he met all the cheques and he paid them. At the date of the failure there was stock to the value of £500 in the Queen Victoria Street showroom. He could not say whether any of the stock purchased from the General Electric Company in November found its way to Messrs. Huddleston & Co., but it was possible that was the case, as the money raised from that firm was required for payment of wages. One of the claims against the estate was by Mr. Egenham, the

manager of the London office. Witness engaged him on the condition that he invested £100 in the business at 5 per cent. interest as security for his fidelity. That £100 was paid into the general banking account, as witness contended he had a right to use it in the business. There was no ground for the suggestion that any electrical stock had been made away with. A dynamo at the back of the Harold Wood premises had been sold, and the proceeds duly accounted for. Every particle of assets had been handed over to the trustee, and, in fact, witness did not retain sufficient to provide himself with a dinner on the following day. Mr. Hough said that completed his cross-examination, but he required the debtor to file an account showing in detail the goods that had been pledged, the dates of pledging, the prime cost, the amount of the advances, and if, and when, the goods were paid for. The debtor undertook to file the account, remarking that he had given every information to the trustee, who had told him that he never had a better bankrupt through his hands. The cross-examination was accordingly adjourned to April 16th next.

We are pleased to note from the *London Gazette* that a dividend of 20s. in the £ and interest is to be paid on March 19th, in the case of C. A. Church, of Hampstead Road and Kentish Town Road (Henry Connolly & Co., manufacturing electrical engineers).

Dissolutions and Liquidations.—Creditors of the North-Eastern Telephone Company must send particulars of debts, &c., to the liquidator, Mr. C. Humble, 12, West Street, Gateshead, by April 15th.

Creditors of the Porcelain Electrical Fittings Company must send particulars to Mr. T. W. Hayes, 24, Cheapside, Hanley, the liquidator, by March 17th.

A meeting of the Electric Incandescent Lamp Regenerating Syndicate is to be held at 8, Clifford's Inn, E.C., on April 9th, to hear an account of the winding up from the liquidator (Mr. A. Banister).

Messrs. M. Walker and W. H. Collingham (Airedale Motor and Accessories Company, of Keighley) have dissolved partnership.

A winding-up order having been made recently against the Automobile Manufacturing Company, Limited, the statutory meetings of the creditors and shareholders were held on Tuesday last at the Carey Street offices of the Board of Trade, Lincoln's Inn Fields, W.C. Mr. A. S. Cully, Assistant Receiver, reported that the company was registered on April 30th, 1900, for the purpose of acquiring the goodwill and assets of the business of electrical engineers carried on by W. C. Bersey & Co., at 4, Hythe Road, Willesden, together with the business of the Southern Motor Car Company, carried on by Edmund Townsend and A. E. Bizzey, at 59, Brixton Road, S.W. The company was registered with a nominal capital of £100, but the amount was almost immediately afterwards increased to £15,000. The reason for originally registering the company with a capital of only £100 was that it was desired to protect by registration the name of the company, and at that time neither the amount for which subscriptions should be invited, nor the amount of the purchase price had been decided upon. For the same reason the registration was effected without articles of association, and although draft articles were subsequently prepared, they had not been registered nor formerly adopted by the company in general meeting. The promoters were Mr. W. C. Bersey (vendor), Mr. Edmund Townsend (vendor), and Mr. Stanley Lambert (chartered accountant). A prospectus, dated June 14th, 1900, invited subscriptions for £5,000 shares, and was stated to have been issued only privately among friends of the directors. As a result, on July 25th, 1901, the company allotted the whole number, but subsequently, for various reasons, the allotments in respect of 1890 shares were cancelled. The total cash issue was £3,192 shares, of which £2,240 was subscribed by the directors themselves. The purchase price to be paid by the company was agreed at £10,000 in shares and £130 in cash, the latter amount being in respect of the promoting expenses up to allotment, which charges were defrayed by the vendors. No valuation was made of the assets, nor was any balance-sheet prepared upon which to base the purchase price. On September 20th, 1901, a debenture bond of £10,000 was issued to certain directors of the company to secure them in respect of a guarantee given by them to secure an advance of £5,000 made to the company. It was not until the company was in difficulties that the debenture bond was issued to the directors. The circumstances under which that issue was made would be a matter for inquiry. A sum of £5,500 was now due under the debentures. Commenting upon the share-holding of the directors, the Chairman stated that Mr. Lambert, a promoter and director of the company, received £1,000 vendors' shares for his services in the promotion, and it would be for the liquidator to consider whether the fact of Mr. Lambert's interest in the promotion was properly disclosed. The accounts filed under the liquidation showed liabilities £3,787 against assets £3,718, but if the issue of debentures was upheld there would be a deficiency of £6,000 to the creditors. Resolutions were passed at both meetings for the Official Receiver to remain in charge of the liquidation.

Messrs. Arthur Allen and H. F. Ward (Allen & Ward), electrical and general engineers of Birmingham, have dissolved partnership. Mr. Allen attends to debts, and continues the business as Arthur Allen & Co.

A meeting of Williamson & Joseph, Limited, is to be held at the offices of Messrs. T. P. Child & Son, 42, Poultry, E.C., on April 15th, to hear an account of the liquidation proceedings from the liquidator (Mr. T. P. Child).

Books Received.—"Tramway Companies and Local Authorities," by Frank Noel Keen. London: Merritt & Hatcher. 1902. 10s. net.

"The Elements of Physical Chemistry," by H. C. Jones. London and New York: Macmillan & Co. 1902. 17s. net.

"Street's Newspaper Directory for 1902." London: British, Foreign and Colonial Advertising Offices. 3s. 6d.

Catalogues.—The "Rapid" Magnetting Machine Company, of Cambridge Street, Birmingham, have placed in our hands an illustrated circular describing their "Rapid" electrical magnetting machine, or separator, which they manufacture for the purpose of extracting iron or steel from metal borings and dust of all kinds, and other non-magnetic materials containing particles or pieces of iron or steel which require to be separated. Some statements are arranged in parallel columns for the purpose of comparing the "Rapid" machine with those of older types, and pointing out its advantageous features.

The B.T.H. Co.'s pamphlet, No. 120, is devoted to a description of the Thomson astatic instruments for direct current switchboards.

Messrs. J. P. Hall & Co., of Oldham, have brought out a new price list of their multipolar ventilated enclosed shunt-wound motors for continuous running. Prices are also given in tabulated form of liquid and metallic starting switches and fuses.

A bulky and very fully illustrated price list of engineers' and joiners' tools and machinery has been placed before us by Messrs. C. Nurse & Co., of Walworth Road, S.E. It is intended as a supplement to the firm's No. 10 catalogue, issued in 1899, since which date a number of new lines have been added to their stock. The very vast field which is covered in the catalogue makes it impossible to detail the contents, and, furthermore, this is, we should think, quite unnecessary, the supplies of Messrs. Nurse being well known to most of our readers.

Mr. C. Olivetti, of Ivrée, has sent us a circular of his new watt-meter and Wheatstone bridge.

Messrs. R. W. Blackwell & Co. are just now sending out lists of their reduced prices for I.T.E. circuit breakers.

Messrs. Cochran & Co., Annan, Limited, have sent us a tiny pocket calendar giving particulars of their Cochran boilers, also a monthly stock list.

Fire.—On the 4th inst. a fire occurred on the premises of Messrs. de Puydt & Poncin, of Marion Street, Birkenhead.

For Sale by Auction.—Messrs. Huddleston & Co. will, on March 24th, offer a large quantity of electrical apparatus for sale by auction at Hammersmith. Particulars are given in our business pages to-day.

Large Steel Works Installation.—The Upper Forest and Worcester Steel and Tinplate Works, Limited, have recently laid down a very complete electric lighting and power scheme at their works. The boilers supplying the bar-mill engine have been utilised for the electric lighting plant, the pressure from these being 100 lbs. per sq. in. The power house is built of stone, and measures 53 ft. 4 in. long, and 34 ft. 10 in. wide. The present plant installed consists of a pair of Marshall compound condensing engines, with cylinders 11 in. and 19 in. by 30 in. stroke, of the L.C.H. class. Between the engines is fitted a 10-ft. fly-wheel running at 110 revolutions per minute, transmitting its power to the generator by nine ropes. The valves on both steam and exhaust are of Marshall's latest double-beat type. The generator is of Parker's standard compound-wound two-pole type with three bearings, capable of an output of 360 amperes at 250 volts when running at a speed of 480 revolutions per minute. The main switchboard is built of six panels of Sicilian marble on angle iron standards. Solid bare copper mains have been used throughout, the largest being ·5 in. diameter, and the smallest being No. 12 B.W.G.; the whole of the mains are carried upon iron standards or brackets, no timber being used where deterioration from weather would take place. The arms carrying the insulators are also of iron, and a layer of hard wood is inserted between the insulator and the iron, so that should a wire break loose from its insulator it would still be partially insulated from the ironwork of the carrier.

The incandescent wiring is carried out on the distribution board system. The number of incandescents installed is approximately 450, of 16 and 32-C.P., special fittings having been designed for the different departments. The arc lamps are arranged two in series; they are 7-ampere standard Jandus lamps, with clear globes. Each pair of lamps is wired direct from a distribution board, and Braulik patent arc lamp couplings are used throughout (with the exception of the casting pit). The outside lighting is carried out with arc lamps suspended from iron poles; the latter are made from Great Western Railway bridge rails, two rails being riveted together by the flanges face to face. All arc lamps (with the exception of those over the casting pit) are counterbalanced, no winches being used. The present installation consists of 60 arc lamps, 14 of which are erected in the steel works.

The management express great satisfaction at the manner in which the installation, designed by Mr. W. M. Furniss, chief engineer to Messrs. Handley & Shanks, has been carried out by that firm, and add their appreciation of the services of Mr. Furniss, who was ably assisted by Mr. A. E. Jones, mechanical engineer to the Upper Forest Works.

Meeting of Creditors.—A meeting of creditors of Lewis Bayliss, trading as the Thames Electrical Manufacturing Company, Terrill & Co., and Cardwell & Co., was held at 37, Waterloo Street, Birmingham, on the 10th inst.

New Edition.—A third and extended edition of W. Perren Maycock's "Electric Wiring, Fittings, Switches and Lamps," has just been issued by Messrs. Whittaker & Co., of Paternoster

Square, E.C. The whole book has been revised, and considerable additions made to the practical examples at the end, these being now placed by themselves in a separate chapter.

New Shade Carrier.—The "Century" Shade Carrier Syndicate, of Marlborough Works, Manchester, have sent us a sample of their speciality, which consists of a collar provided with a flange to support the shade, and a screw for clamping the carrier upon any ordinary lampholder. The shade is fixed in position by means of a pair of clips which can be bent down over the edge of the shade. The device is very neat, enabling one to fix or remove any shade in a moment, and it will fit any existing lampholder.

The St. Petersburg Exhibition.—We have before us a prospectus of this Exhibition, which is to be opened on June 3rd, and to remain open until September 2nd next. The Exhibition is to be confined solely to the manufacturers and producers of the British Empire. Full particulars are given of the objects of the Exhibition and the necessity for British firms to bestir themselves if they are to maintain an industrial position of importance in Russia. All inquiries regarding space should be addressed at once to Mr. Herbert Harris, authorised agent, 191, Coventry Road, Birmingham. The secretary for the United Kingdom is Mr. Edgar Gorer, of 22, Conduit Street, Regent Street, W.

The E.L.B. System in Spain.—We are informed that the Electric Lighting Boards Company have had a patent skirmish in Spain, where they have taken action against Messrs. Oteyza and Urena, of Madrid, who, it is alleged, were trying to infringe the company's patents and had copied the company's catalogues. The attempted infringement called the company's attention to the prospects of Spanish business, and steps were taken to accord to Messrs. Paz & Sylva, of Paris, a temporary license of the Spanish patents for the Spanish coronation, which takes place on May 17th; this firm, who have been so successful in representing the company in Paris, immediately commenced operations on a large cale in the Spanish capital, one of their first contracts being from the Government Fêtes Committee.

Trade Announcements.—Messrs. Bennett & Ward-Thomas, consulting engineers, of 13, Victoria Buildings, Manchester, have removed to larger offices at Winter's Buildings, Manchester.

The directors of the E.L.B. (Brit. Mfg. Co.) ask us to state that, after taking legal advice, they have determined the agreement under which Messrs. Hereford, Lavey & Chapman have acted as their sole selling agents. We are informed that litigation is pending as to the termination of the agreement.

The registered offices of the Rand Central Electric Works have been moved to 120, Bishopsgate Street Within.

Messrs. Hedges, McKrell & Taylor, Limited, electrical and mechanical engineers, formerly of 31 and 34, Barbican, wish to notify their customers that the business is now being carried on at their works, 39, Baltic Street, Golden Lane, as hitherto. Mr. H. E. McKrell has resigned his position as director, and is now in no way connected with the company. Mr. H. H. Sparkes still remains with the company, and is authorised to collect any debts owing to the company in the name of the receiver (Mr. H. J. Taylor), and to carry on any business on their behalf.

Vickers, Sons & Maxim.—The directors' report, which is to be presented at the meeting to be held to-day at Sheffield, contains the following paragraph:—"The directors wish particularly to bring to the notice of shareholders two of the firm's subsidiary companies, both acquired during 1901—The Electric and Ordnance Accessories Company, Limited, and the Wolseley Tool and Motor Car Company, Limited, both of Birmingham, and both manufacturing articles that appeal to the individual as well as to the Government or Corporation. In the former, together with fuses and small war material, electric fittings of many sorts are made. The latter firm manufactures the already well-known 'Wolseley' motor cars, and starts the year with most favourable prospects, and with orders that will find them full employment till late in the year. These works are now turning out a motor car each day, and it is hoped shortly to increase that output."

Whittaker's Mechanical Stoker.—In this stoker, according to illustrations before us, that are not very clear themselves and are not at all fully described, the grate bars are of the ordinary fixed type; the bridge of firebrick is not vertical at the grate end, but slopes away at an angle of about 30°. Coal is brought from an overhead hopper between a pair of small crushing rollers to prevent pieces above a given size from passing. As the fuel drops upon a plate below the rollers it is constantly swept away by revolving blades, which throw it over the surface of the grate. The difficulty with all the continuous or intermittent sprinkler types of stoker is the collection of too much fuel at any one area of the fire surface. In order to obviate this difficulty, there is fixed a horizontally-projecting plate, off which the fuel, as it flies forward, will glance. This plate is capable of being slightly varied in its angle by means of a screw and arm, thus affording a means whereby the fuel will be deflected more or less, and compelled to distribute itself nearer to or further from the bridge as may be necessary. There is also a clearer plate to enable any fuel that may fall upon the dead plate to be removed. It is claimed that the lodgment of coal on the dead plate gives rise to black smoke. We do not ourselves quite see that this should be the case—rather the reverse. However, it is claimed to be of advantage to employ this clearer device because, by its use, there is no need to open the fire door to push the fuel off the dead plate, and the boiler may be worked for an hour or two without opening the doors, thus keeping out excess of cold air. If the apparatus will, as claimed, produce a level and even fire, it has solved one of the difficulties of sprinkling stokers. The machine has but few moving parts, merely one fan or shovel shaft, a worm and wheel, and a reciprocating bar, which carries four pawls to actuate ratchet wheels on the crusher roller spindles, whereby the two rollers of each furnace hopper of a Lancashire boiler are slowly revolved at intervals to feed in the coal, the rollers doing a double duty as crushers of large pieces of coal and as feed rollers. This mechanical stoker has been made for 20 years by Mr. Whittaker, of Burnley, Lancashire. As with all stoking machines applied to internally fired boilers of Lancashire type, the hoppers of this machine are high up above the firing floor, and require laborious filling. Where possible, coal conveyers should always be arranged for filling these hoppers. The want of such means has, we are sure, been a frequent and patent cause why mechanical stokers have been rejected in places where otherwise they might have done well.

ELECTRIC LIGHT AND POWER NOTES.

Alnwick.—The ducal town may next winter be lighted with electricity, as the U.D.C. has decided to negotiate with the Northern Counties Electricity Supply Company on the subject.

Auckland.—The Edmundson Syndicate have informed the U.D.C. that the negotiations with the Cleveland Electrical Company for supply to Bishop Auckland in bulk have fallen through; they, therefore, propose to begin at once with the work of putting down a station for the supply of electricity in Bishop Auckland.

Bangor.—The L.G.B. has sanctioned the Council's borrowing £12,008 for the purpose of electric lighting and a refuse destructor.

Bridgend.—Application has been made to the L.G.B. by the U.D.C. for power to borrow £4,000 for lighting the district by means of electricity. The South Wales Electrical Power Distribution Company are being approached with the view of getting tramways to the town from the many seaside and other suburban resorts around.

Broadstairs.—The U.D.C. has decided to accept the offer of the Thanet Tramways Company to supply electricity for lighting purposes to the Council at 2½d. per unit. Private consumers will have to pay 6d. per unit.

Broughty.—The T.C. has decided to put its prov. electric lighting order in force, and has instructed Mr. G. Balfour, electrical engineer, Dundee, to prepare the necessary plans &c.

Colchester.—The U.D.C. has resolved that £8,500 be borrowed for electric lighting extensions.

Dorking.—The U.D.C. has come to a definite conclusion in the matter of electric lighting, having agreed to transfer the prov. order to Messrs. Edmundson. The sum of £25,000 has been mentioned as the amount required for the undertaking; the town will raise the funds, and lend them to the firm, who will repay the principal and interest in yearly instalments. The Council will have the option of purchasing the concern after seven, 10 and 14 years, and at the end of 25 years the undertaking becomes the property of the town without further payment.

Dublin.—The Lighting Committee of the Corporation proposes the adoption of a charge for lighting of 4½d. per unit for the first two hours' use per day throughout the year of the maximum demand, and 2½d. per unit afterwards. The Committee further recommends a rate for electrical power of 2½d. per unit for the first four hours per day, and 1d. per unit afterwards. Any less quantity to be charged for at the rate of 7d. per unit for the first hour, and 1d. per unit afterwards.

Dungannon.—Representatives of Messrs. Smith and Parkes, electrical engineers, Belfast, have placed before the U.D.C. proposals for laying down plant for the electric lighting of the town, and a committee has been appointed to consider the matter.

Farnham.—Messrs. Roger Dawson, Limited, have offered to lease the U.D.C.'s proposed electric light undertaking on the lease-purchase basis of a profit equivalent and a 6 per cent. dividend guaranteed by the Council, the company to find the capital, and profits exceeding 10 per cent. to be equally divided. The charge for public lighting would be 3½d. per unit. The Council has decided to take Sir William Preece's advice.

Frinton-on-Sea.—The U.D.C. has given a provisional consent to the application of a local electric light company for an order for public and private lighting.

Germany.—The Exposition of Dusseldorf-sur-Rhein, which is now in process of organisation and will open on May 1st, will be lighted throughout by electricity, while the same agent will be used as motive power. In this connection it is interesting to note that two central power stations are at present in course of construction, which will supply electric energy under three different forms:—(1) simple alternating current at 10,000 volts; (2) three-phase current at 5,000 and 2,000 volts; and (3) direct current at 2 × 220 volts, 220 volts, and 2 × 115 volts. The two stations will comprise 26 engines and 27 dynamos of a total power of 15,000 H.P. An interesting feature will be a three-phase motor of 1,000-H.P., driving a mine pump.

Glamorgan.—The County Council Committee has decided to take electrical energy for lighting the County Asylum from the South Wales Electrical Power Distribution Company. The aggregate is estimated at 100,000 units per annum.

Hoddesdon.—The U.D.C. has had under consideration the desirability of supplying the town with electric light under the order obtained by the Council, and has thought it advisable to wait until the North Metropolitan Supply Company lay their trunk main in connection with the electric trams for Cheshunt.

Hornsey.—The U.D.C. has decided to increase the number of public arc lamps from 20 to 60. The estimated annual cost of energy and maintenance of the 60 lamps is £1,292 17s 6d.

Italy.—A new *régime* for the control of concessions of catchments of water is under consideration. The Minister of Public Works has decided that the consideration of applications for concession of water catchments is to be temporarily suspended. The following concessions for catchments have been applied for, for industrial purposes:—The Società Elettro-Metallurgica Lombarda has applied to the Prefecture of Bergame for the concession of a catchment of 1,200 litres per minute, with a head of water of 140 metres, capable of furnishing 2,240 H.P., for the production of electric energy. The Società Emilio Basso, of Genoa, has asked for the concession of a torrent on the Costagintta, with a view to constructing a reservoir of 400,000 cubic metres. It is proposed to develop power to work an electric tramway along the Riccio Valley from Pontedecimo to Busalla. M. Carlo Borgarello has applied to the Prefecture of Turin for a catchment on the course of the Sanglio, for the development of motive power to be converted into electric energy.

Kimberley.—The Cape Government, on being approached on the subject, has offered to lend the T.C. a sum of £10,000 for electric light extensions. This assistance is much needed, as all the available plant is already required to contend with the increasing load, there being no "stand-by" in case of breakdowns. In the ordinary course, the Council would have presented a private Bill to Parliament, for extension of borrowing powers, but under the present state of war and rebellion in the Cape Colony, Parliament is not likely to meet for some time to come.

London.—L.C.C.—The Council last week decided to advance to the Southwark B.C. loans of £6,150 and £6,725 for electric lighting works and meters.

The report of the Highways Committee in reference to the prov. order applied for by the Bermondsey B.C. for the districts of Rotherhithe and St. Olave, recommending the Council to ask the B. of T. to amend the order by reducing the maximum charge from 8d. to 6d. per unit, was again considered.—Dr. Cooper proposed, as an amendment, that the recommendation should be referred back to the Committee for further consideration, on the ground that the proposal of the Committee would create two rates in the same area, one of 8d per unit and the other 6d. The B.C. was charging a price of 6d. and 2d. per unit.—Mr. Phillimore said that it was not the business of the Committee to decide whether Bermondsey ought to be able to claim exemption from the general principle which the Council had endeavoured to establish for the whole of London. The Council had a duty to perform, and that was to protect small consumers all over London.—Mr. G. A. Baker, vice-chairman of the Committee, said that if the amendment were carried, the action of the County Council in endeavouring to secure a maximum rate as low as possible would be entirely stultified. If Bermondsey desired to charge a maximum rate, it was quite as easy to have 6d, with 2d. or 1d. for succeeding hours, as to fix 8d. The maximum rate of 6d. was inserted in the four or five prov. orders which were granted last year. The amendment was defeated, and the recommendation of the Committee carried without further discussion.

WESTMINSTER.—The L.C.C. has decided to make a certain payment to the Westminster City Council upon the completion of the work connected with the supply and erection of arc lamp columns, in the portion of the Strand now being widened in connection with the Holborn—Strand improvement scheme. The City Council proposes to substitute electricity for gas lighting throughout the Strand.

An explosion took place in Panton Street, Haymarket, on Tuesday night last week, two distributing boxes being blown up and a building set on fire. The mains affected belong to the Charing Cross and Strand Corporation.

WOOLWICH.—It has been decided to inaugurate the maximum demand system in April. The M.B.C. has decided to reduce the charge for energy supplied to the Grand Theatre from 4½d. to 4d. per unit. The theatre's account for 1901 amounted to £900, averaging 4·03d. per unit.

The London County Council has sanctioned a loan not exceeding £6,000 for the purchase by the Woolwich M.B.C. of the Blackheath and Greenwich Electric Lighting Company's undertaking in the parish of Eltham, but an inquiry has been ordered as to the actual cost of the Eltham portion of the undertaking before the loan is advanced.

Maritzburg.—The E.L. Committee of the T.C. recently recommended the ordering of plant for the electric light department, in accordance with the engineer's estimate, to a total amount of £1,716. There was also a recommendation that eight additional transformers be ordered from England at a cost of approximately £640.

Middlesbrough.—The sanction of the L.G.B. has been given to the loan for the proposed extension of the works.

Newcastle.—Eighty of the new arc lamps erected by the Corporation in the principal streets were switched on for the first time last week. There are to be 200 in all.

Newcastle-under-Lyne.—An inquiry into a scheme for the provision of electric light in the borough was held last week by Mr. A. A. C. Malet, on behalf of the L.G.B. The Corporation applied for sanction to borrow £1,815 for the erection of electricity works on land in its own possession adjoining the gasworks. There was no opposition to the scheme.

Rochester.—The rating appeal by the E.L. Company against the assessment of the St. Nicholas Guardians, Rochester, has been settled by accepting the valuation made for the Medway Union by Messrs. Eve. This reduces the assessment from £320 to £102.

St. Annes.—The U.D.C. has lowered the charges for electricity from 7d. and 4d. to 7d. and 2d., with the alternative of a flat rate of 5½d. per unit, and 4d. for power and heating.

Salford.—The T.C., being uneasy as to the state of the electrical undertaking, has decided to institute an inquiry into its affairs from the commencement, in 1891, to the present day.

Servia.—A despatch from Belgrade states that a concession has just been granted to a syndicate of Servian capitalists for the exploitation of a catchment on the River Morava for the development of hydraulic power, to be transformed into electric current. The preliminary works will require an expenditure of 1,000,000 f. The basin of the Morava is the most important hydraulic centre in Servia. It can furnish a power of about 6,000 H.P.

Southampton.—Reporting to his Electricity Committee on the electricity works, Mr. H. F. Street stated that the direct current plant was very inadequate to cope with the existing and increasing demand both for lighting and traction, and that the battery was suffering from overwork in consequence. Moreover, the space available on the present site was so limited that little improvement could be effected. Mr. Street, therefore, advised that an entirely new station should be built on a new site at the earliest possible moment. Mr. Street's recommendation was at once accepted, and a site selected on the western shore which afforded ample facilities for condensing and for obtaining coal, as well as for future extensions. Further, the land belongs to the Corporation.

The present capacity of the generating plant is 660 KW. Mr. Street recommended that two new 500-KW. sets be obtained, which, with the existing plant, will suffice to meet the expected demand of 1,200 KW. next winter. The total cost of the extensions is estimated at £28,000, but an economy of £1,600 a year is anticipated from the improved conditions of working.

The Committee accordingly recommended to the Corporation that application be made to the L.G.B. for leave to raise the loan, and that the tender of Messrs. Dick, Kerr & Co., Limited, for the two generating sets, be accepted at £4,257 each. These proposals have been accepted by the Corporation, the amount of the loan being increased to £30,000.

Southgate.—The D.C. has received a petition from 34 influential gentlemen in the parish, stating that they observed with alarm the action the Council had taken in the electric power matter by opposing the North Metropolitan Electrical Power Distribution Company's Bill before Parliament, and demanding that a public meeting of ratepayers be held to state their wishes. It was agreed that the chairman should confer privately with the signatories as to the intentions of the Council with regard to electric power.

Southport.—On Tuesday last, Col. Durnford, L.G.B. Inspector, held an inquiry into an application of the T.C. for sanction to borrow £32,000 for purposes of electric lighting. It was stated that of this sum £9,000 had already been expended, and the remainder was for new works rendered necessary by the growth of the electricity department. The last similar loan was sanctioned in 1899 for £55,300, and that would be expended by the 31st inst. For the year ending March 31st, 1899, the income of the undertaking was £9,382, and for the eleven months of the year ending March 31st, 1902, the income was £17,091. The units sold in 1899 were 606,000; in the eleven months ending March 31st, 1902, they were 1,385,000, while the consumers had risen from 533 to 1,010, and the lamps from 36,000 to 63,000. The amount asked for covered the anticipated expenditure up to March 31st, 1904. Mr. R. S. Downe, borough electrical engineer, gave particulars of the extensions, &c., and stated that the Corporation expected to supply electric power to work the Pier Company's trams, and there would be a further demand for the additional tram-lines to be laid in the streets, in addition to which it was proposed to light Chapel Street Station (L. & Y.) by means of arc lamps. There was no opposition.

Switzerland.—The city of Zurich is about to utilise the mountain torrents of the country for a great electric power scheme. With the co-operation of Cantons Schwytz and St. Gall, the Marsby Valley behind Einsiedeln, once the site of a lake 11 miles square, is again to be converted into a lake by means of water from the torrents of Grossbach, Reichenbach, and Sihl. The difference of level between this valley and that of Lake Zurich is about 600 ft., and this huge fall will give 60,000 H.P. The work will take three years, and will cost £1,600,000.

Walton-on-the-Naze.—A company has been formed with a capital of £20,000 to acquire the Walton Mills and Harbour, and to apply for a prov. order for lighting the town by electricity. The U.D.C. has raised no objection.

Welsh Notes.—The Llanelly (Carmarthenshire) new dock equipment is to be provided for mainly by means of arc lamps, with a considerable number of incandescent lights. A 25-H.P. engine and a dynamo is also being put down by Messrs. Alger and Sons (the Llanelly contractors) at the Alyn Tinplate Works, Mold, Flintshire. Messrs. Alger have also just completed a colliery installation, and they have another in hand.

At Barry Dock, Mr. Bailey at his important ship-repairing yard is supplementing his electric arrangements with two complete generating plants.

Westbury.— The Guardians are considering the advisability of adopting a scheme of electric lighting at the workhouse.

Whitby.—The inaugural ceremony of switching on the U.D.C.'s electric light installation, which has cost £18,500, took place on Wednesday last week.

Wimbledon.—In our note under this heading last week some regrettable errors occurred. It should have been stated that the figures for output for private and public lighting and for revenue, apply only to the last quarters of the years 1900 and 1901. Further, the charges on the maximum demand system are 7d. and 2d. on a 1½ hours' basis, not 7d. and 1d.

Wolverhampton.—The T.C. has decided to extend the electric mains at an estimated cost of £2,500.

Worksop.—The L.G.B. has sanctioned the loan of £8,000 for extensions of the U.D.C.'s electricity works.

ELECTRIC TRACTION NOTES.

Africa.—Presiding at an extraordinary general meeting of the African Concessions Syndicate, Limited, held at 120, Bishopsgate Street Within, E.C., Mr. W. A. Wills, the chairman, said it was intended that an expedition should be despatched as soon as possible to survey the Victoria Falls, in Rhodesia, and plan out the electrical installation to be ultimately erected when a power company had been formed to provide the concession with working capital, the amount of which would run into very large figures, probably £1,000,000 sterling, or more. It would be found practicable, he hoped, to use the power of the Falls for the traction of the railway trains on the Cape to Cairo railway, for a distance of, say, 150 miles north and south of the Falls, or 300 miles in all.

Belgium.—La Société des Tramways Bruxellois is establishing a large new electricity generating station at Anderlecht, near Brussels. The plant will be on the three-phase system, of 6,000 H.P. capacity.

Blackburn.—There was another long debate on tramway matters at the T.C. last week. The Electricity and Tramways Committee, replying to certain criticisms of their policy at the previous meeting, submitted a report in justification of the types of cars, motors, and other equipment they had adopted. The four-motor were better than the two-motor cars, the report stated, for the reason that they provided the more satisfactory method of propulsion, securing more even driving, better starting, greater speed, a more equal distribution of driving and brake power, with consequently less wear and tear on brake-shoes and wheels, and greater safety—a matter of paramount importance on the Blackburn gradients. These advantages were held to more than compensate for the higher price paid for the cars compared with that paid by the Darwen Corporation for their two-motor bogie cars. As to the comparative weight and motor horse-power of the Blackburn and Darwen cars, the former are 13 tons and are 80 H.P., whilst the latter are 11 tons with varying horse-powers of 54, 70, and 80. The committee consider varying types of machinery such as this to be inadvisable in Blackburn. A uniform horse-power for cars is preferable, so that they are able to run upon any gradient, whilst another recommendation is that it is more economical and simple in the provision of the necessary spare motors and gear, which must always be kept ready to hand. If there be any increase in the energy consumed by the four-motor cars, it is trifling, and, in comparison with the advantages gained, not worth consideration.

The Committee defend the use of the larger type of car as being more suitable to the irregular passenger traffic of Blackburn, and consider the 48 cars now running to be quite the right equipment for the regular service. The local service, they point out, is intermittent, and not comparable with that of other cities and towns where a tolerably equal traffic is maintained throughout the whole day. Forty cars daily, it is added, will be required during the summer months, and on certain days in the winter 35 cars have been running regularly. Turning to the expenses of working, &c., the report states that the capital spent on the cars is fairly productive. On the present basis of fares, a fully worked car will earn about £1,800 per annum, while the interest and sinking fund amounts to about £67 per annum, so that there is a considerable margin to meet working expenses and depreciation. If a car only ran a full five weeks in the year, it would earn its capital charges and the five weeks' working expenses; and if the cars are sufficiently well patronised they will be remunerative to the necessary extent. In all towns, it is added, there is a great difference between summer and winter traffic, the number of cars at Bolton, for example, being 81, but not more than 50 are used on any one day during the winter. Dealing with the point that the order for 20 additional cars from Messrs. Dick, Kerr & Co. ought not to have been placed, the Committee point out that there was great delay in the delivery of the first batch ordered, and the cars are £160 each cheaper if no specific time for delivery is mentioned. If the contemplated extensions in Blackburn, for which the cars were ordered, do not take place, equitable arrangements for cancelling the order can, no doubt, be made with Messrs. Dick, Kerr & Co. The Committee explained that the large quantity of rails in stock is accounted for by the fact that they were purchased in view of an immediate extension of the trams to Audley; and they protest, in conclusion, against the unfairness of making comparisons between the cost of tram working in various towns, because the conditions are, in no two cases, exactly the same.

An animated discussion followed on this report, and on a proposal to extend the trams to the borough boundary at Wiltshire at a cost of £14,600.

On a division, the recommendation of the Committee to carry out the Wiltshire extension was affirmed by a large majority.

Burton-on-Trent.—The scheme for the introduction of electric tramways into Burton-on-Trent is making marked progress. The engineers have completed their plans, and advertisements are to be issued for tenders for the permanent way and paving. The bulk of the work will be carried out by the borough officials. Property has been purchased in various parts of the town for depôts and other purposes. The first instalment of £50,000 is being raised by the Corporation.

Canada.—The official returns compiled by the Department of Railways of the Canadian Government state that on June 30th last 40 electric traction companies possessed 675 miles of railway completed, 670 miles being laid with steel rails, and 158 miles being double track. The paid-up capital amounted to £8,000,000, of which municipal aid accounted for £35,000. The gross earnings aggregated £1,200,000, and the working expenses £700,000, leaving the net earnings at £500,000. The number of passengers carried was 121,000,000, and the freight 288,000 tons. The car mileage was 32,000,000. Ontario has 386 miles, Quebec 197, New Brunswick 12, Nova Scotia 10, Manitoba 18, British Columbia 51. The passengers carried by the street railways were: Montreal, 46,000,000; Toronto, 38,000,000; Ottawa, 7,500,000; Quebec, 3,700,000; Hamilton, 3,700,000; Winnipeg, 3,200,000; Halifax, 3,000,000; St. John, 1,700,000; Vancouver, Victoria, and New Westminster together, 5,300,000.

Central London Railway.—A few days ago a Parliamentary paper was issued giving certain appendices to the Board of Trade report on the question of vibration. They include a memorandum by Mr. A. Mallock on the vibration caused by the trains, with explanatory notes, and a list of experiments made in 1901 on train vibrations.

Crewe.—The T.C. last week decided to apply for an order to construct light electric railways in certain parts of the borough.

Dundee.—The Tramways Committee has been discussing what type of car to adopt for the Constitution Route, and a combination car has been decided upon. The manager of the tramways is to visit certain English towns for the purpose of seeing the working of routes similar to Constitution Road.

Glasgow.—The case between Mr. Simpson, Albert Road, Pollokshields, and the Glasgow Corporation regarding the latter's cars running at an excessive speed, which has been before the Courts for the fourth time, recently came up for further hearing. It was averred that in September the cars passed the complainer's house at a speed exceeding the B. of T. limit, viz., eight miles an hour, on 24 different occasions, and that the full penalty, £10 for each offence, should be imposed under the Railway Clauses Consolidated Act (Scotland). After hearing evidence, the Sheriff was of opinion that only two infringements were as libelled, and he imposed the maximum for each with three guineas expenses—£23 in all. Counsel for the Corporation asked his Lordship to state a case for appeal to the High Court of Justiciary, Edinburgh, so that more will be heard of this case.

Halesowen.—Last week a Light Railway Commissioners' inquiry was held here as to the expediency of granting an application by the R.D.C. for an order to extend the light railways in the district. The Commissioners expressed themselves as favourable to the application, and will report.

Ilford.—The construction of the U.D.C. electric tramways was commenced on the 6th inst.

Ilkeston.—The town will be in possession of its electric tramways by the month of August. Work was only begun in November, and the rails are already laid and the poles in position over practically the whole route, about three miles. The line is a single one throughout, with five or six passing places. The Corporation have concluded an arrangement with the Derby and Notts Electric Power Company for the supply of electric power, and the company will erect works at the southern end of the borough. Electricity will be supplied to the Corporation at 1½d. per unit, plus 10 per cent. for "transformation," and it is understood that they will retail it to consumers for lighting at 4d. per unit. The

contract for the laying of the tram line and electric cable and for the supply of the cars, which amounted to £38,884, is in the hands of Messrs. Dick, Kerr & Co.

Leeds.—Mr. Bailie Hamilton, some time traffic manager to the Glasgow Corporation tramways, has been unanimously appointed general manager of the Leeds Corporation tramways without the vacancy having been advertised.

Liverpool.—A proposal for the establishment of a universal 1d. fare, made by Mr. F. Saunby, was considered at the last meeting of the Liverpool Tramways Committee. In the course of the discussion, Alderman Smith stated that the average fare on the Liverpool tramways at present was 1$\frac{1}{6}$d., and that, as the total receipts were now £460,000, the loss by establishing a universal 1d. fare would be £40,000. The proposal was ultimately withdrawn.

Merthyr.—The Electric Traction Company have appealed against their rating of £2,400 gross and £1,200 rateable, and asked the Assessment Committee to reduce it to £2,250 (total), it being pointed out that as yet there was no absolute valuation criterion, as the public had gone in for big patronage at first owing to the novelty of the affair; but the Committee confirmed the assessment.

Manchester and Liverpool.—The express railway scheme passed its second reading in the House of Commons on the 6th inst.

Motherwell.—The Hamilton, Motherwell and Wishaw Tramways Company is about to break ground in connection with its Motherwell tramway scheme.

Newcastle-on-Tyne.—The Council last week considered the propriety of promoting a Bill in Parliament for the extension of the tramways. The Bill refers to the proposed extension in Walker, Benwell, Fenham, Gosforth, Weetslade, and Wallsend. The motion was adopted without discussion. The cost was said to be £149,812 for construction and £116,000 for equipment. These figures had been reduced from £201,000 for the construction and £196,000 for the equipment, certain lines having been deleted.

Oldham.—The Ashton Road tram route was inspected by Major Druitt last Friday. The section consists of 1,100 yards of double track.

Paris.—The Paris correspondent of the *Financial Times* says that a Tramway Trust, with a capital of 30,000,000 francs, is on the eve of being formed for the purpose of financing the North-West Parisian Electric Tramways Company and another company, both of which are subsidiaries of the Cie. Générale de Traction. The names of the Westinghouse Electric Company, the Electric Light and Power Company, Mr. Rockefeller, and M. Rouvier are mentioned in connection with the formation of the new trust. The formation of the trust is subject to the acquisition from the authorities of certain concessions for tramway extensions.

Richmond.—The T.C. has arrived at an understanding with the L.U.T. on the following basis:—(1) 30-years' purchase period; (2) wayleave, £1,250; (3) last year's general stipulations as to paving, fares, widenings, &c.; (4) £20,000 towards rebuilding the Red Lion Street area.

Spain.—A concession has been granted for the construction and working of a narrow gauge electric railway between Puente de los Fierros and Morteras de la Romia. The route is a very hilly one, requiring the use, on a certain portion, of the Abt rack rail system. It is proposed to utilise the water power of the River Pajares in the generation of the necessary electrical energy.

Sunderland.—A meeting of the Tramways Committee of the Sunderland Corporation was held on the 6th inst., when a scheme for the construction of a line to the South Docks in that town was considered, but was rejected on the ground that the cost was excessive. An estimate was made as to the cost, which was returned at £13,455, compared with £8,000 a mile in the other parts of the town. This was due to the fact that the road levels would have to be altered at a very considerable expense. The cost of interfering with gas and water mains, and of making a junction, &c., would further increase the estimate by £1,255. The expenses of the existing route average 8¼d., whereas the expenses for the route in question would be 10d. per car-mile. Under these circumstances the committee decided to recommend the Council not to proceed with the scheme.

Sweden.—A commission was recently constituted by the Swedish Government with the object of studying the advisability of substituting electric traction for that of steam on the Swedish railways. The conclusions of the commission are distinctly favourable to the adoption of electricity, Sweden being obliged to import nearly all the coal she consumes from abroad, whilst she possessess numerous waterfalls hitherto unutilised, which could easily be converted into motive power. The commission in question has made a study of these waterfalls, indicating those that might be conveniently adopted for this purpose. Only those falls which are capable of giving at least 1,500 H.P., and which are situated sufficiently near the railways to permit of the economical transmission of energy have been considered; a few falls somewhat distant, have, however, been taken into consideration in view of their great force. In view of this decision of the Commission the Swedish Government has decided to hasten as much as possible the completion of the preliminary studies of the project with a view to place the matter before Parliament next session.

London United Extensions.—The Highways Committee of the L.C.C., in the course of a report on the London United Tramways Bill, mentioned that a petition had been received from certain inhabitants of Hammersmith, asking that the Council's consent should be given to the company's proposals as regards that borough, and that a deputation from the Borough Council had supported the scheme. After having conferred with representatives of the company, and given the matter further consideration, the Committee expressed the opinion that it was desirable that two of the projected short lengths of lines, with the necessary connections, should be constructed as soon as possible, as it had been represented that they would be of great service in linking up portions of the company's existing system in Hammersmith, and affording further facilities for communication. The tramways in question, which were described in the Bill as Nos. 4, 4*a*, 4*b*, and 5, would be between Glenthorne Road and Goldhawk Road, and between Goldhawk Road and Uxbridge Road, together with two small junction lines. The Committee were, however, of opinion that these short tramways should be constructed and owned by the County Council, and should be leased to the company, but that the lease should not extend beyond 1909, when the company's existing lines in London, of which the new tramways would form part, would become purchasable by the County Council. While adopting this view in regard to the short sections of line, the Committee were still of opinion that the Council should not give consent to the other proposed lines in the county, as they would not be so intimately connected with the company's existing system, and as the Council itself would probably revive its proposals which had to be withdrawn last year, on account of want of co-operation from the local authorities along the same routes. The Committee therefore recommended the Council to give consent to the introduction of the company's Bill, in so far as it related to the two lines and junctions referred to, and on condition that the promoters undertook to amend the Bill, so as to provide for the construction of these particular tramways by the County Council, and be leased to the company on terms to be hereafter arranged. The consideration of the recommendation was adjourned.

St. Helens.—After being dragged on to an inordinate length, the negotiations between the Corporation of St. Helens and New St. Helens District Tramways Co. with reference to the carriage of goods over the tramways, have come to a deadlock. The Town Council at a special meeting adopted a resolution that, "Unless and until the letters from the solicitors to the Tramways Company to the town clerk, of February 17th and 22nd, 1902, and the claims therein made, be absolutely withdrawn, with an undertaking that they shall in no event be again advanced by them or on their behalf, all negotiations are at an end." At a meeting of the Council last week a further letter from the Tramways Company's solicitors was read, and gave rise to a long discussion. The purport of the letter was that the company had not previously threatened the Council to run goods without charge, but that they had intended to inform the Council that it was the view of their legal advisers that the company might take up that position under their lease, but they were prepared to come to an agreement with the Council which would have the effect of putting an end to all such contentions which had been made. The letter was referred to the joint Parliamentary and Electricity Committees of the St. Helens Town Council.

Wallasey.—The electric tramways were informally opened on Thursday last week, when a trial car, with members of the District Council, was run over the whole route.

Walsall.—The T.C., on Monday, decided to erect a central tramway depôt on land at the Birchills at a total estimated cost of £12,430. The Tramways Committee were authorised to obtain tenders and to enter into contracts for the purchase of 28 cars for working the existing tramways and the proposed new tramways at an estimated cost of £16,100.

Warrington.—On Tuesday, Light Railway Commissioners conducted an inquiry at Warrington respecting the application of the Warrington Corporation for powers to construct a light railway as an extension of their tramways system through Stockton Heath and on to the Latchford swing bridge. After hearing evidence, the Commissioners decided to submit an order to the Board of Trade. Certain provisoes as regards road widths and fares were, however, made.

West Bromwich.—The Highways Committee of the T.C. have just issued a lengthy report with respect to the reconstruction and electrical equipment of the tramways in the borough. According to this document it appears that when the plans, details, specifications, and estimates were under consideration the representative of the South Staffordshire Tramways Lessee Company, Limited, and the Birmingham and Midland Tramways Company, Limited, raised an objection on the ground that the expenditure involved was too high. In order to get rid of the objection, the Committee decided to try and fix a lump sum for the work, and after some negotiations the tramway representative offered to agree to the sum of £100,000 as the cost of reconstructing and equipping the lines in West Bromwich, provided that the paving of the permanent way in the High Street between the General Post Office and Spon Lane, and in Great Bridge between Willenhall Road and Brickhouse Lane with hard wood be given up, and that Mr. Quin's

safety device, if used, be attended to and set for the service each by employés of the Corporation at the Corporation expense. The Committee, the report states, were assured by the engineers that the work could be satisfactorily carried out for the sum of £100,000, therefore they recommended that the offer be accepted by the Council on the conditions mentioned, with the exception of that as regards the safety device, which the Committee are of opinion should be attended to by the employés of the company.

Wolverhampton.—At a meeting of the T.C. on Monday a letter, dated March 1st, was read from Mr. Henry Lea, M.Inst.C.E., 38, Bennett's Hill, Birmingham, the expert appointed by the Corporation, stating that he had carefully investigated the Lorain system of surface contact traction. "My report," he adds, "will be a full one, and will be illustrated by drawings. I fear that I shall be unable to complete this report in time to send it to you two or three days before the 7th inst. It will, however, probably serve your purpose if I now say, briefly, that I have been unable to discover any inherent defects in the Lorain system which should prevent the Corporation from giving the contractors official notice to proceed with the equipment of the remainder of the 11·373 miles of single track under Clause 8 of the contract between the Corporation and the Lorain Steel Company." The report has since been received, and is now in the hands of the town clerk, but it is first to be placed before the Tramways Committee and to be considered by them before it is issued to the public.

York.—A poll was recently taken by the Corporation regarding their Parliamentary Bill. One of the main points considered was that of the tramway system. The voting was as follows:—Purchase of tramways, 5,381 for, 6,673 against; additional tramways, 4,717 for, 7,484 against.

ELECTROMOBILE NOTES.

Rail v. Road.—The comparison of the performances and efficiencies of electric road cars with electric railways and tramcars is most instructive. The paper on "Electric Traction on Railways," by Messrs. Mordey and Jenkin, now being discussed at the Institution of Civil Engineers, makes such a comparison of special interest just now, viz.:—

Electric Railways—	Speed in miles per hour.	Watt-hours per ton mile.	Authority.
City and South London	13	83·8	Prof. Kennedy.
Liverpool Overhead ...	15	70	
Dublin Tramway ...	8	91·7	
Waterloo and City ...	14	41·8	
Central London... ...	—	48	

(96 watt-hours per ton-mile is the total, including electric lifts, &c.; of this 48 is taken as approximately correct for car-service.)

Electric Road Cars.—	Speed in miles per hour.		Watt-hours per ton mile.	Authority.
Columbia, U.S.A.	13·3		130	"Elec. Rev.," Nov. 22nd, 1901, page 864, article on "Long Runs on One Charge."
B.G.S. Co., France	10		130	
National Motor Carriage Syndicate, England	10	Hard level roads	140	
	12		86	
	14		119	
British and Foreign Vehicle Company	11·5		138	
Baker Motor Co., U.S.A.	8		78	
Krieger Car, France	12·4		115	

The tractive resistance, or draw-bar pull, in the case of electric railways on smooth steel rails is 10 to 12 lbs. per ton.

The tractive resistance, or draw-bar pull, of the electric roadcars was over 50 lbs. per ton, on the average, and on the hills met with on the long runs the tractive resistance was at times over 100 lbs. per ton, so that the proportion with equal speeds between the City and South London Electric Railway, 13 miles and 83·8 watt-hours per ton-mile, and the Columbia Electric Road Car, 13·3 miles and 130 watt-hours per ton-mile would be:—

City & South London Electric Railway.	83·8	With a tractive resistance of 12 lbs. per ton.
Columbia Road Vehicle ...	31	In inverse proportion 50 lbs. to 12 lbs. per ton.

Take another example:—

Waterloo and City Electric Railway at 14 miles and 41·8 watt-hours per ton-mile, and the National Motor Carriage Syndicate's electric vehicle, at 14 miles and 119 watt-hours per ton-mile.

Waterloo and City	41·8	Tractive resistance at 12 lbs. per ton.
National Motor Carriage Syndicate Road Vehicle.	28·5	In inverse proportion of 50 lbs. to 12 lbs.

In this comparison the watt-hours per ton-mile given for the electric railways is the average of all the energy generated, and includes the loss in generators, conductors, converters, and balancers, as well as car losses, whereas, in the electric road vehicle, the energy is that actually used on the car, and to this should be added 25 per cent. for loss between charge and discharge of batteries. With such an addition, the comparison would read:—

	w. h./t. m.		w. h./t. m.
City & South London Electric Railway	83·8	Columbia Road Car	39
Waterloo & City Electric Railway	41·8	N. M. C. Syndicate Road Car	35·6.

The great differences still remaining between the two systems can partly be accounted for by loss in the conductors and balancers; but, making every allowance, the efficiency of the road vehicle on common roads, in comparison with the electric trains on steel rails, is greatly in favour of the electric road vehicle, and furnishes food for reflection.

The Automobile Club.—The following members have been appointed as an Electrical Committee, viz.:—Mr. Roger Wallace, K.C., Mr. Theodore Chambers, Mr. J. S. Critchley, M.I.M.E., Mr. Henry Edmunds, M.I.M.E., Mr. R. E. Erskine, Mr. J. M. Gorham, M.I.C.E., Mr. J. Ernest Hutton, J.P., Mr. E. H. Cozens-Hardy, Mr. Ralph Lucas, Mr. J. O'Gorman, Mr. Llewellyn Preece, Mr. G. E. B. Pritchett, Mr. Henry F. Joel, A.M.I.C.E., Mr. Edward Manville, M.I.E.E., Mr. A. G. New, Mr. C. Opperman, Mr. Percy D. Northey, M.I.M.E., and Mr. Paris E. Singer. This Committee, from which, by the way, the professors who officiated at the club trials of electrical vehicles at Chislehurst, 1900, are conspicuous by their absence, has already met and recommended a further series of trials of electric road cars in June of this year, special attention being given to the tests and the necessity of obtaining information for the improvement of electric road cars.

The Committee recommends the following programme of trials on six successive days:—

First day, London to Brighton, small cars, to have an optional course in London.
Second day, Brighton to London, or ditto.
Third day, Sandown and back, or ditto.
Fourth day, Windsor and back, or ditto.
Fifth day, Ascot and back, or ditto.
Sixth day, special tests in London.

A very comprehensive series of runs and on routes that will enable the public, or those of the public that are interested, to have an opportunity of seeing the cars day by day.

The Committee have arranged for the following:—

Weights of batteries, cars and load, each separately,
Draw-bar pull of each car,
Mechanical / Efficiency } with all electrical data,
Recuperation,

as well as all details of construction, sizes of wheels, and other useful information. We heartily congratulate the Automobile Club on their energy and good sense in appointing a committee of practical men to advance the interests and assist in the improvement of electric road cars.

In addition to the work of the Committee, this enterprising club invited the editor of the *Automotor* to read a paper on "Electrical Vehicles" at their house dinner on February 26th last; the paper was read by Mr. Lucas, and was followed by a most interesting discussion. Surely the learned institutions and societies are lacking when they allow what was originally a social club to take up their functions and supply the demand for information on such up-to-date subjects as electric road cars.

Mr. Swinburne took the chair at the meeting, and in the discussion that followed, Mr. Opperman, Mr. Henry F. Joel, Dr. Playfair, Mr. Northey, Mr. Leitner and Mr. Chambers took part. Mr. Joel gave figures obtained from various authorities as to the cost of different cars, viz.:—

Petrol car, 1d. to 1½d. per ton-mile.
A steam car burning petrol, 3d. per ton-mile.
A heavy steam vehicle with coke fuel, 3d. per ton-mile.
An electric car, taking the unit as costing 1½d., 9d., or less than 1d. per ton-mile.

Electromobiles in London.—Electric road cars are making headway in London. The elegant electric broughams introduced in London by Mr. Paris Singer are far in advance of the previous London Cab Company's cabs, being lighter, more economical, and more reliable in every way. Mr. Paris Singer says he is full of orders, and that all his time is taken up in supplying the cars.

A new electric omnibus is shortly to be put on the streets of London by the London Road Car Company. It is stated that the weight of this electric omnibus, exclusive of batteries, will be about 3 tons. This weight appears to be high and retrogressive; the tendency is to reduce the weights of electric vehicles, whilst their strength is maintained by better construction. We hope to have further particulars, and to give our readers a full opportunity of judging for themselves as to the practicability of the venture.

TELEGRAPH AND TELEPHONE NOTES.

Mansfield Telephones.—The Mansfield Council has been in communication with the Woodhouse U.D.C. asking for its support in a proposed application for a municipal telephone license. The proposed rates under the scheme would be as follows:—For an exchange connection, £6; for message rate connection, £3 and 1d. per originating call up-to 720, and after that number ½d.

Australian Telegraphs.—A Melbourne dispatch to the *Sydney Daily Telegraph* (January 27th) reads as follows:—

The deadlock in the negotiations between the Federal Postmaster-General and Mr. Warren, representative of the Eastern Extension Company, with reference to the Cape cable is broken. In reply to a letter from Senator Drake, the company's Australian manager wrote on January 23rd, saying that he would procure the needed information from his London directors as to the two points in the existing contracts with Tasmania, New South Wales, South Australia and West Australia. The two points referred to are:—(1) A clause whereby contracts are indeterminable except by mutual consent; and (2) clauses under which the Australian Governments are required, directly the Pacific cable is opened, to construct and maintain for practically the exclusive benefit of the Eastern Extension Company special wires from Adelaide to the South Australian border, and from Sydney to the New South Wales border. The Federal Government requires a vital alteration with respect to clause 1, and requests information of a technical character as to the wires contracted for under clause 2 before it can see its way to submit a draft Federal agreement in substitution for the separate State contracts, and include Victoria and Queensland in its scope. The prospect of having to give the Eastern Company a series of land lines connecting Adelaide, Sydney, Melbourne, and Brisbane is not viewed with pleasure by the Postmaster-General and his advisers. Mr. Warren expects a message from London in a few days, however, which should pave the way to a definite understanding between the Cable Company and the Federal Government.

Glasgow Telephones.—The Secretary of State for Scotland has consented to the Corporation increasing its borrowing powers for telephone purposes from £120,000 to £220,000. Mr. Bennett, the general manager and engineer, is to be retained for another two years and to receive £500 as manager and £500 in lieu of commission on engineering work carried out under him as consulting engineer, either party reserving the right to terminate the engagement or arrangement at March 1st, 1903, on giving three months' notice. The wages of the 82 employés of the department are to be increased, and a scheme for grading the salaries of the various classes is to be submitted by the manager.

Southport Telephones.—The Telephone Committee of the Corporation have resolved that the Postmaster-General be requested to fix the period for the telephone license to expire on December 31st, 1912, and to fix the charges suggested by the Council.

Telegraph Construction in Northern Nigeria.—The High Commissioner of Northern Nigeria, Brigadier-General Sir F. Lugard, K.C.M.G., C.B., D.S.O., in his report for the year 1900-1901, just issued, states that the construction of the telegraph line from Lokoja to Ibi, on the Benné, was arrested by the hostility of the Munshi tribes. A strong expedition was organised, and by the end of March last the Munshi country to the north of the Benné had been traversed by the troops and severe loss inflicted on the tribes in a series of engagements. The natives use poisoned arrows of a very deadly kind, and are said to be a constant source of trouble. The principal chiefs, however, made submission, but the season was too far advanced to admit of the extension of the telegraph beyond Akwaneja, on the borders of Munshiland, 100 miles from the Niger. The staff employed had already completed their period of service, and the medical authorities deprecated their stay during another rainy season in the unhealthy swamps and forests of the Munshi country. The lines completed are (1) that from the Lagos frontier to Jebba (connecting with Lagos), and (2) thence to Lokoja, together with the extension from Lokoja to Akwaneja. A line has also been cleared southwards along the Niger bank for some 25 miles, and poles have been erected along this for 15 miles. The lines now urgently required are said to be as follows:—(*a*) The completion of the Lokoja—Ibi line, which it is proposed to carry further to the north of the Benné, so as to avoid the Munshi country. (*b*) A line to connect a new site of the European settlement which it is proposed to establish further down the river from Lokoja with the Niger, and to be continued through Kontagora to Illo.

The Telegraph Wire Export Trade.—February proved to be a relatively quiet month as regards the export trade of this country in telegraph wire and apparatus connected therewith, the shipments only attaining a value of £126,330 tons as compared with £586,285 in January last, and £126,510 in February, 1901. For the two months ending with February last, the exports have amounted to £712,615, which compares with £722,632 in the corresponding two months of last year.

Underground Telegraphs.—Last week the Postmaster-General received a deputation from Chambers of Commerce in the North, who urged upon him the necessity for extending the underground telegraph cable to the north. In reply, the Marquis of Londonderry stated that the main underground line to Birmingham had cost £165,000. The line had been extended as far as Stafford, and would this year be carried on to Warrington, where it would join the existing underground line between Liverpool and Manchester. A section of the line north from Preston had also been laid for a distance of about 30 miles; it had been selected because all the main west coast lines converged there, and the route they traversed was exposed. It would form a link in the intended extension of the line to Scotland. From Manchester it was in contemplation to extend the underground line northwards through Leeds to Newcastle-on-Tyne, and various towns en route would benefit by that extension. But the lowest computation of the cost of an underground line between London and Glasgow was £700,000. It would be for the Chancellor of the Exchequer to decide what amount of money he would allow annually in order that the scheme they had in view might be carried out. The real crux of the situation was pounds, shillings, and pence. It was far more a Treasury matter than a Post Office one, and he thought that that important deputation should wait upon the Chancellor of the Exchequer and ask for his views upon the subject.

Wireless Telegraphy.—A Reuter dispatch dated Ottawa says that Marconi was on Wednesday to sign a contract by which the Government will grant him a subsidy of $80,000 for the erection of a station on the Nova Scotia coast. He says he believes he can communicate from that point with Cape Town.

CONTRACTS OPEN AND CLOSED.

OPEN.

Birkenhead.—March 18th. Balancer, boosters, switchboard and battery, for the South End generating station. See "Official Notices" March 7th.

Bournemouth.—March 15th. Coal and ash conveyors, bunkers, &c., for the Corporation tram station. See "Official Notices" February 28th.

Boston.—Firms willing to carry out the Council's electric lighting and tramways order are invited to communicate with the chairman of the Lighting Committee. See "Official Notices" February 28th.

Brighton.—March 24th. Telephone cables, conduits, poles, instruments, wires, batteries, switchboards and various other materials for Corporation telephone system. See "Official Notices" February 28th.

Devonport.—March 26th. Permanent way, bonding, &c., for over three miles of track for the Corporation. See "Official Notices" to-day.

Edinburgh.—March 31st. Arc lamp carbons, cast-iron pipes, also road box frames, covers, &c. See "Official Notices" to-day.

Ghent.—March 20th. The latest date for sending in tenders for the establishment of electrical works has been extended to March 20th. The original advertisement appeared in our "Official Notices" on January 3rd.

Hackney.—April 9th. Three water-tube boilers, water softener, &c., for the electricity works. See "Official Notices" February 28th.

Halifax.—March 24th. Water-tube boilers, superheaters, 200-KW. rotary converters, 75-KW. transformers, and high tension switchboard for the Corporation. See "Official Notices" to-day.

Heckmondwike.—March 15th. Piping, traction generator, battery and booster, switchboard work, condenser, cooling tower, feeders, &c., for the U.D.C. See "Official Notices" February 28th.

Ilford.—March 24th. Cars, trucks, motors and equipments. See "Official Notices" February 21st.

Ilford.—March 27th. U.D.C. wants tenders for overhead line equipment, poles, feeder cables, &c. See "Official Notices" March 7th.

Leeds.—March 17th. The Corporation wants tenders for installing electric light in the underground conveniences at Kirkgate Market, Leeds. Particulars may be obtained at the City Engineer's Office, Leeds.

Madrid.—April 5th. Tenders are invited by the Spanish Government, to be received not later than April 5th, for the supply of 15 tons of bronze wire for the Government Telegraph Service. Some particulars may be examined at the Commercial Department of the Foreign Office.

Manchester.—March 27th. Steam and other piping and tanks for Stuart Street generating station for the Corporation. See "Official Notices" to-day.

Oldham.—March 25th. Piping, pumps, tools, &c., for the Greenhill electricity station. See "Official Notices" February 28th.

Oulton.—The Mutford and Lothingland Board of Guardians are considering the question of providing an electric light installation for the workhouse at Oulton.

Penang.—April 28th. Boilers, condenser, pumps, pipes, steam dynamos and balancer booster, switchboards, batteries, cables, junction boxes, arc and glow lamps, posts and accessories, for the commissioners of George Town. See our "Official Notices" to-day.

Plymouth.—March 25th. Electricity meters, cables, and transformers. See "Official Notices" March 7th.

Plymouth.—March 25th. Lancashire boilers and stokers, piping, condensers, valves, &c. See "Official Notices" March 7th.

Rockhampton (Australia).—March 31st. The Council of the Municipality of Rockhampton is prepared to consider applications from companies desirous of undertaking the construction and working of a system of electric tramways under the Queensland Tramways Act of 1882, and the Amendment Act of 1890. See Electrical Review, January 10th.

St. Pancras.—March 14th. Overhead travellers for the Council. See "Official Notices" February 28th.

St. Petersburg.—March 25th. The Executive Board of the municipality is wanting tenders for the installation of a temporary telephone station for 900 subscribers. Full particulars are given in our advertisement pages to-day of the various apparatus and instruments and cables required.

Salford.—March 22nd. Electric motors up to 3 H.P., ditto, from 4 to 15 H.P., also starting switches and resistances, for the Corporation motor hiring scheme. See "Official Notices" March 7th.

Southend.—April 2nd. Electric wiring propositions are wanted by the Corporation. See "Official Notices" to-day.

Spain.—March 29th. The *Board of Trade Journal* says that for the third time tenders are being called for the installation and working for 15 years of the electric light in the "Carcel Modelo," Madrid, at the upset price of 40,000 pesetas, or about £1,164 per annum, payable in monthly instalments. A provisional deposit of 2,000 pesetas, or about £58, is required to qualify any tender. The number of lamps and other particulars may be learnt upon application at the Secretariat of the Prison Committee, situated in the "Prisión Celular," Madrid.

Spain.—April 1st. The Spanish Post and Telegraph authorities in Madrid are inviting tenders until April 1st for the supply of 136 tons of iron wire 4 mm. diameter, and 5 tons 5 mm. diameter. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas 10, Madrid.

Spain.—April 3rd. The Spanish Post and Telegraph authorities are inviting tenders until April 3rd for the supply of 15 tons of copper wire. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, 10, Carretas, Madrid.

Stepney.—March 20th. Cables and conduits for electric lighting. See "Official Notices" March 7th.

Southampton.—March 26th. Trolley wire, poles, rail bonds, &c., for the Corporation tramways. See "Official Notices" to-day.

Stoke-upon-Trent.—March 26th. Engine and dynamo, electric motor, &c., for the Guardians. See our "Official Notices" to-day.

Sunderland.—March 26th. India-rubber cable and cast-iron pipes for electric light department. See "Official Notices" to-day.

Wallsend.—March 19th. The Council wants tenders for a refuse destructor, electric lighting machinery, electric crane and motor for driving same. The destructor must be capable of dealing with 300 tons of ashpit, privy and general town refuse per week. Pug mills to grind the resulting clinker. The electric lighting machinery to light the destructor and adjacent street and public quay. The crane, to lift 5 tons, is to be erected on the quay. Mr. George Hollings, borough surveyor.

Warrington.—April 9th. Steel rails and permanent way work, also overhead equipment for Corporation tramways. See "Official Notices" to-day.

CLOSED.

Admiralty.—Messrs. Easton & Co., Limited, have received the contract from the Thames Ironworks, Engineering and Shipbuilding Company, Limited, the contract for the supply and erection of the whole of the machinery required to operate the eight sliding and three floating caissons which the company are supplying to the Admiralty for the new docks at Keyham. The plant in question comprises the hauling and lifting gear for the caissons and caisson decks, drainage pumps, air reservoirs and sluices, and the usual small gear, the whole being driven by compressed air engines, while the necessary apparatus for working the caissons by hand is also included. The contract price is between £50,000 and £60,000.

Brighton.—The T.C. has accepted the tender of Messrs. Witting Brothers, for the supply of 10 additional electric cars at £576 per car complete. There were 14 tenders, the highest figure quoted being £751 per car. On Saturday March 1st, Mr. Tilly, who owned the local 'bus service, withdrew all his 'busses from the routes, owing to the competition with the Corporation cars.

Colchester.—The U.D.C. has provisionally accepted the tender of Messrs. Davey, Paxman & Co., to supply and fix a steel "Economic" boiler, capable of evaporating 10,000 lbs. of water per hour, for the sum of £920.

France.—The French Post and Telegraph authorities have just given out some large orders for telegraph wire as follows:—La Société Metallurgique de Gorcy, 12 tons of galvanised iron wire, 1 mm. dia. at 415 fr. per ton, and 80 tons ditto, 4 mm. dia., at 247½ fr.; La Société des Forges de Franche-Comté of Besançon, 100 tons ditto, 3 mm. dia. at 203 fr., and 60 tons ditto, 4 mm. dia., at 198 fr.; Messrs. Lefort & Co., of Mohon (Ardennes), 80 tons ditto, 4 mm. dia. at 259 fr.; and Les Trefileries du Havre, 80 tons ditto, 4 mm. dia., at 259 fr.

Glasgow.—The following contracts have been let by the Corporation Tramways Committee:—

Messrs. McDowall Steven & Co., Glasgow, pole base castings &c., £1,631. Messrs. Glenfield & Kennedy, Kilmarnock, a hydraulic direct lift platform hoist at Kinning Park depôt, for £178.

The Corporation Telephone Committee has accepted the following:—

The Telegraph Manufacturing Company, Helsby, extensions to Bridgeton Telephone (Branch) Exchange, £44. Messrs. Jas. Allen, Senr. & Son, and Messrs. Walter McFarlane & Co., Glasgow, cast-iron pipes for street mains, £1,020 16s. 8d. The British Insulated Wire Company, dry core cables, £2,901 12s. 6d.

Messrs. Mavor & Coulson are to supply electric motors (£253) for the exhibition organ, which is to be erected at the Glasgow Art Gallery and Museum.

Leigh.—The tender of Messrs. W. R. Renshaw and Company, of Stoke-on-Trent, for the supply of a 400-H.P. "Accessible" water-tube boiler at £707 has been conditionally accepted by the Tramways and Electricity Committee of the T.C. The Committee has also accepted the tender of Messrs. Cowans, Limited, to supply one dynamo panel and two feeder panels for the switchboard at the electricity station at £349.

Manchester.—Contracts to the extent of £30,000 have been let by the Electricity Committee of the Manchester Corporation. Messrs. Mather & Platt, of Salford, have secured contracts for surface condensers &c., at the Stuart Street station.

Newport, Mon.—Messrs. Broadbent & Sons, who have contracted to supply an overhead travelling crane for the new Corporation power station at Newport, objected to the penalty for delay provided in their contract, and the Corporation have agreed to reduce it from £50 to £15 per week.

The accepted tender for the new power station, car and repair sheds and chimney shaft, for Newport County Council, is that of Messrs. A. S. Morgan & Co., the particulars being as follows:—

Power station	£16,146 10 5
Chimney shaft	2,439 2 11
Car sheds and repair shops	4,901 18 8

It is, however, proposed to substitute for the ordinary brick chimney shaft, one of a specially light design, by the Alphons Custodis Company, of Sheffield, the price of which will be £1,630, thus effecting a considerable saving.

Walsall.—The T.C. has entered into the following contracts:—

Messrs. William Griffiths & Co., Limited, of London, for the construction of permanent way, £35,827 9s. 9d. Messrs. Robert Blackwell & Co., Limited, for overhead equipment of the tramways (except the Bloxwich extension), and also for the re-equipment of so much of the existing lines in the borough as extend from the top of Park Street to Mellish Road, £7,480 7s. 3d. Callender's Cable and Construction Company, Limited, for high tension cable and tramway feeder, £6,444 12s. 1d.

West Bromwich.—The Corporation has accepted the tender of Mr. George Law, of Kidderminster, for the construction of permanent way for 14 miles of route.

The Committee also recommend the Council to accept the following tenders in connection with the work:—Rails, Messrs. Bolckow, Vaughan & Co., Limited, Middlesbrough; tie-bars, Guest, Keen, and Co., Limited, West Bromwich; points and crossings, Hadfields, Limited, Sheffield; poles, J. Spencer and Co., Limited, West Bromwich; overhead equipment, bonds and cables, The British Insulated Wire Company, Prescot.

Woolwich.—The M.B.C. has accepted the lowest of the following tenders for 200 210-volt 32-C.P. lamps for public lighting in the Plumstead area:—

Name.	Lamp.	Price.
General Electric Company ..	"Robertson" ..	1s. 5d.
Sunbeam Lamp Company ..	"Sunbeam" ..	1s. 8d.
Hiram Maxim Lamp Company ..	"Maxim" ..	1s. 1d.
Zurich Lamp Company	"Stearn"	1s. 2d.
Fuller, Macleod & Co.	— ..	9d. plain, 10d. frosted.

The existing 230-volt lamps are to be superseded.

Wolverhampton.—The Tramways Committee recommend the purchase of six double-decked cars from Messrs. Dick, Kerr & Co., at £515 10s. per car.

FRANKFORT ELECTRICITY WORKS.

There are probably very few electrical engineers in England who have not at some time or other considered the important problem which is even now before many alternating-current single-phase systems, when a demand for tramway service arises. It is necessary to supply direct current for the traction load, and to determine the best way is a problem not easily solved. The subject has been dealt with at Frankfort on a large scale, and the methods adopted there are worthy of examination.

The central station was built in the summer of 1894 and opened in October of the same year. It is situated outside the town and near to the river Maine. The present plant has an actual aggregate generating capacity of 9,000 I.H.P., including four 750-H.P. steam generators and four 1,500-H.P. sets. The generators are all single-phase, constructed by Messrs. Brown, Boveri & Co., to whom we are indebted for the illustrations which accompany this article.

The load is approximately equally divided into a lighting system and a motor and traction service, the single-phase motors ranging from $\frac{1}{10}$ H.P. to 150 H.P., with 500-KW. motor-generators for the tramway supply. Connections are being made to supply over 5,000 KW. for power and about 7,000 KW. for lighting, and to meet this demand two 4,000-H.P. Brown, Boveri-Parsons steam turbines, running at a speed of 1,360 revolutions per minute, are to be installed, working with superheated steam at 135 lbs. pressure and 300° C.

The accompanying illustrations serve to show the very liberal floor space allowed in the engine room, which measures 23 × 86 metres in plan by 10·5 m. high from the floor level to the eaves. The basement contains steam collectors, piping, cables, a complete oil-purifying installation, and step-down transformers for the station light and power circuits.

The boiler house measures 18 m. × 120 m. Under the boiler house floor there is an ash conduit with a rail track, which communicates with an electric hoist for slag trucks. Behind the boilers is the main flue, which has a cross-section of 3·8 sq. m., and merges at both ends into a chimney 50 m. high and 2·8 m. inside diameter at the top.

Adjoining the boiler house is a coal bunker 11·5 × 120 × 6 m. high. In the centre of the coal house are partitioned off spaces for lavatories, cloak rooms and stores. Under these spaces there is a masonry tank for feed water, supplied by the town waterworks, and having a capacity of 130 cb. m. The hot water tanks are fed from this tank by means of an injector.

The boiler installation consists of 12 patent Kuhn internal flue boilers with Galloway tubes, transverse drums and Tenbrink grates, and six "Simonis & Lanz" automatically fired water-tube boilers, system Münkner.

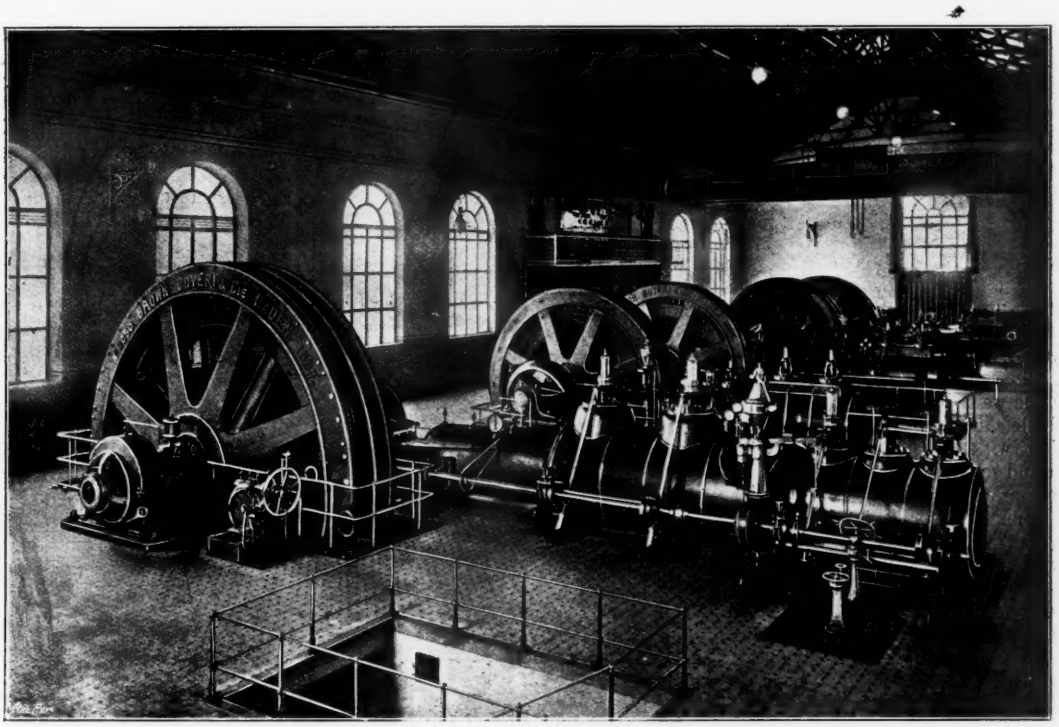


Fig. 1.—General View of Engine Room.

The internal flue boilers have each 1·98 sq. m. grate surface, and heating surface 86 sq. m., the proportion thus being 1 : 43·4. The boilers are 8·78 m. long, and 2·5 and 2·35 m. in diameter. The internal flue is 1·3—1·4 m. in diameter, of corrugated plates, and is strengthened by four Galloway tubes, which also provide for the required circulation of water. Each boiler has a steam dome 1·2 m. high and 1 m. in diameter, on which are arranged the safety and stop valves.

In front of the inclined Tenbrink grate there is arranged a transverse drum which causes the flame to return and to mix again with air, whereby, in combination with the continuous sliding down of the fuel, a good smoke consumption is attained.

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The boilers supply in normal working 17·5, and as a maximum 27·5 kg. of dry steam of 135 lbs. pressure, per sq. m. of heating surface.

The grate surface of each water-tube boiler is 4·56 sq. m., and the heating surface 310 sq. m., the proportion being 1 : 68. Each boiler is provided with two upper drums, each 1·35 m. diameter, and 6·1 m. long. Each of these has a steam dome 850 mm. high, and 700 mm. in diameter.

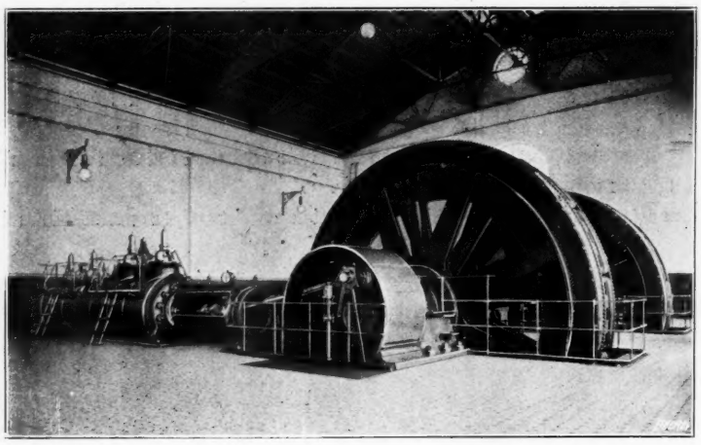

Fig. 2.—Two Single-Phase 1,500-h.p. Generating Sets.

The supply of fuel is effected by electrically-driven Münkner apparatus, by which the coal is delivered in adjustable quantities on to a plate, whence it is thrown uniformly over the grate by means of shovels. These boilers give up to 12 kg. of steam per sq. m. of heating surface per hour.

On the west side there are, besides, six Steinmüller water-tube boilers, having a heating surface of 311·5 sq. m., and working with a superheater of 72 sq. m., which can be cut in and out during working. Each boiler is provided with two upper boilers of 1·2 m. diameter and 6·5 m. long. Each boiler is provided with Leach's automatic fuel-feeding apparatus with four furnaces. These apparatus are driven by electricity. The boilers and the superheater are built for 150 lbs. pressure, and are supposed to give 9 kg. steam of 300° C. per sq. m. per hour.

All the above data as to the evaporating capacity are for the Ruhr coal, of the heating value of 7,500—8,000 calories.

As regards the steam piping, the 12 internal flue boilers are connected with a steam collector arranged in the basement of the engine room. It is 630 mm. in diameter, and is made in two sections connected by a copper bend, each section being capable of being shut off separately by means of valves. For the water-tube boilers, instead of the collector, a circular pipe was chosen, communicating with the collector at two points. In each pipe leading to the engine there is inserted a cast-iron steam drying apparatus. The valves are arranged in such a manner as to enable each boiler and each engine separately to be shut off from the main steam pipe.

The pumps take the feed water from the eight hot water tanks already mentioned, which have a capacity of 20 cb. m. each. The water in these tanks is heated to 90° C. by the exhaust steam from the pumping engines passing through a coil. Each tank has, moreover, an injector for heating it with live steam.

The 750-h.p. tandem compound engines, shown in fig. 1, were supplied by the firm G. Kuhn, of Stuttgart, and their normal power at 120 lbs. initial pressure and 85 revolutions per minute is 560 b.h.p., and maximum 750 b.h.p. The engines are fitted with Kuchenbecker valve gear, and may be worked either as condensing or non-condensing engines. The length of the engine from the centre of crankshaft to the end of cylinders is 9·2 m., the distance between bearings 1·47 m. and 2·48 m. The cylinders are 620 and 960 mm. in diameter, the stroke 1,200 mm. The weight of the fly-wheel is 28 tons, and its diameter 4·8 m.; it corresponds to a degree of sensitiveness of 1 : 200.

The results of steam trials are as follows:—

At 360 b.h.p....	6·99 kg.	per i.h.p. per hour.
„ 578 „ ...	6·775 „	
„ 760 „ ...	7·16 „	

The 1,500-h.p. engines (fig. 2) were built by Messrs. Sulzer Bros., and provided with Sulzer valve gear. The cylinders are 975 and 1,250 mm. diameter, the stroke 1,500 mm. The engines are 13 m. long, and have two bearings 3,740 mm. apart. At 85 revolutions, and at 120 lbs. initial pressure, the engines give 1,500 b.h.p. each as a maximum. The fly-wheel is 6·1 m. in diameter, and weighs 50 tons.

The steam consumption per i.h.p. per hour was found to be as follows:—

At 705 b.h.p.	... ...	6·15 kg.
„ 1,073 „	... ...	6·29 „
„ 1,408 „	... ...	6·54 „

The generators, which were all supplied by Brown, Boveri and Co., of Baden, are built as fly-wheel machines, and generate single-phase alternating current at 3,000 volts, with a frequency of 45 cycles per second. The alternators are direct connected to the steam engines, and their outputs are

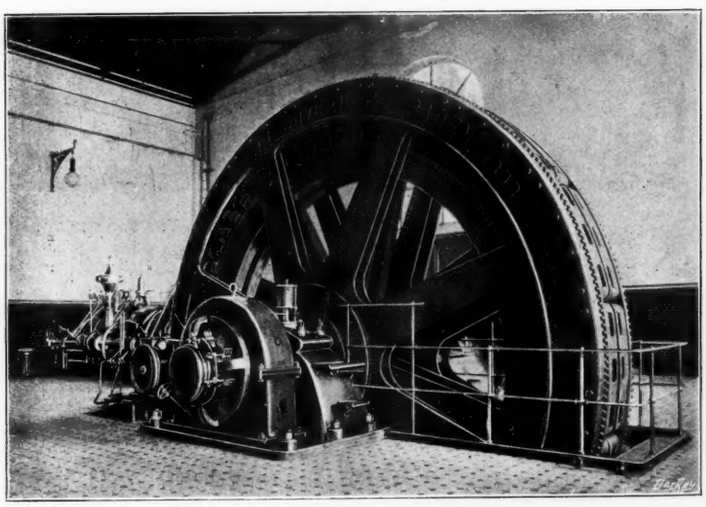

Fig. 3.—Single-Phase Alternator, 1,032 kw.

522 and 1,032 kw. respectively. The field is built directly on the fly-wheel, and is formed by 64 poles. The winding consists of flat copper strip, wound on edge, with intermediate layers of paper. The exciting current is collected by means of two slip rings with double sets of brushes. The armature wheel, which is built round the fly-wheel, is in four sections and rests on two cylindrical supports, round which it can rotate, cast on the main bearings. The arma-

ture consists of 16 segments, each having four spools. The spools consist of a few turns of copper cable and are insulated from the frame by thick paper tubes. The current is taken by two contact blades arranged on the armature wheel and

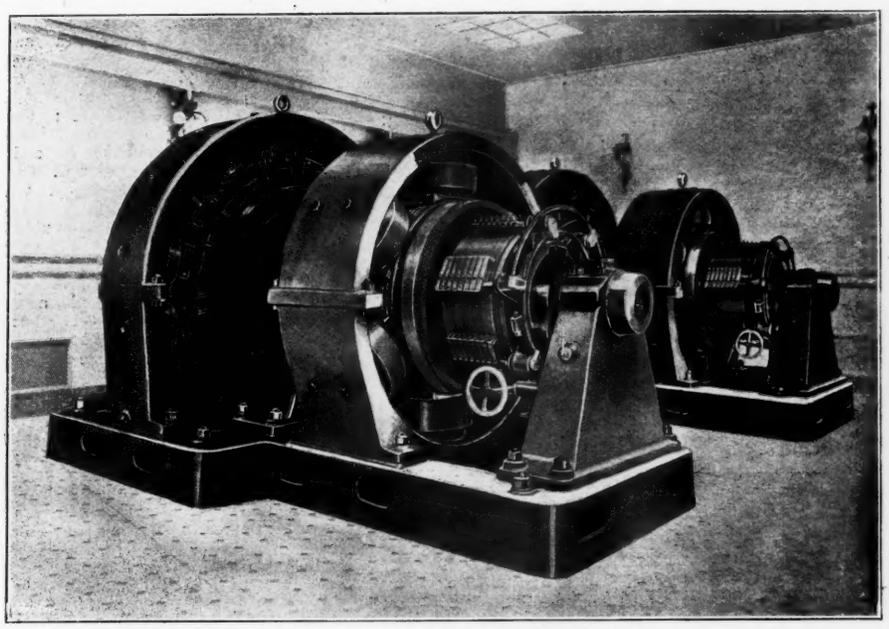

Fig. 4.—Sub-Station; Motor-Generators for Tramways.

engaging with copper springs secured to the foundation of the machine. The armature wheel is held in the right position by means of four bolts screwed into the bedplate. Owing to the armature being rotatable and to each segment being interchangeable, the parts that become damaged can be replaced very quickly. (See fig. 3.)

The exciters are mounted direct on the main shaft and are, for the small alternators, series dynamos of 80 volts 180 amperes, and for the large ones shunt dynamos of 90 volts and 280 amperes.

The passage in the basement in front of the alternators is formed into a cable trench, and contains the alternating and the exciting current cables, mounted on insulators, and conducted behind a wooden partition along the wall towards the switchboard.

The switchboard, seen mounted on a gallery in the background in fig. 1, is of the common Continental type. The front is of white marble, and has no high pressure parts on its surface, all connections being arranged at the back. There are two complete systems of bus bars, one for lighting and the other for power. A main ammeter reads the total current taken by the respective systems.

The mains laid by Messrs. Felten & Guilleaume are concentric lead-covered, with iron armour, the primary and secondary being embedded in sand and covered with bricks to a depth of 70 and 60 c.m. respectively. The transformers have a ratio of 2,850 volts to 125 volts, and were all supplied by Messrs. Brown, Boveri & Co. These transformers are arranged partly in underground pits; others are mounted in or near the consumers' premises.

The tramway motor-generator plant at Schillerplatz is arranged in a spacious station underground. It is connected to the central station by two high pressure feeders of 210 sq. mm. cross-section. The sub-station consists of two chambers, one 20 m. × 9·5 m. × 5·6 m. high containing the motor-generators, and the other about the same size for the battery. The main walls are of concrete, and the roof of iron girders with concrete arches. Electrically-driven fans are provided for keeping the station thoroughly ventilated.

The motor generators (fig. 4) are designed for a working load of 500 KW. each, at a maximum voltage of 550, speed 340 revolutions per minute. They are the well-known Brown-Boveri type of synchronous machine. At the present time there are three installed, and we are informed that no trouble whatever is experienced in running or in synchronising. The guaranteed efficiency at full load is 91 per cent.; at half load 89 per cent. Space has been left for the subsequent addition of a fourth generator.

The front view of the switchboard is seen in fig. 5. No attempt has been made here to prevent access to the back, which presents a mass of innumerable bus bars, both high

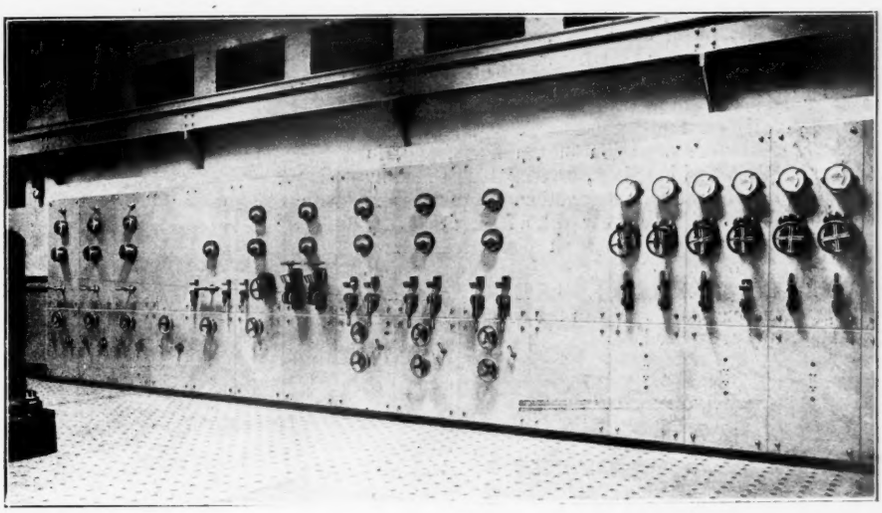

Fig. 5.—Switchboard in Sub-Station.

pressure alternating and direct current, with switches, fuses, ammeter shunts and leads, which are not at all inviting, although we are informed that special attention had been paid to keeping high pressure parts separate from the low pressure.

Referring to the illustration, the traction feeders at pre-

sent installed, six in number, are mounted at the right of the board. The D.C. generator panels, with the blank space for the fourth machine, are shown to the left of them. Further on past the battery are synchronous motor and booster panels,

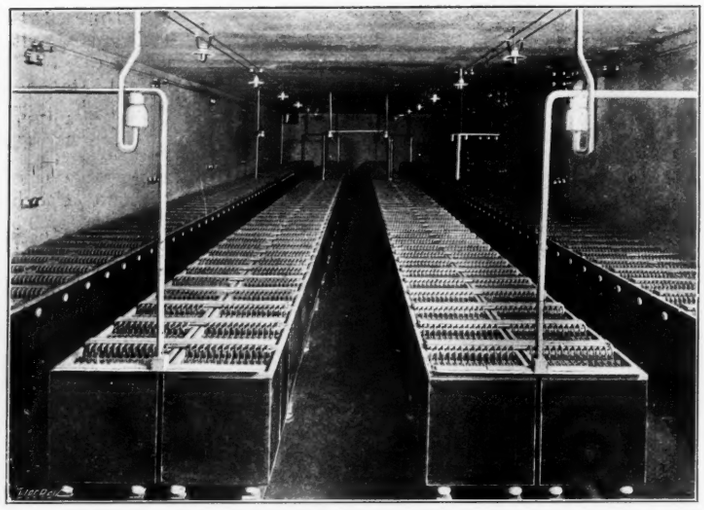

Fig. 6.—Buffer Battery in Sub-Station.

and at the extreme left of the board are the three panels for the high pressure side of the machines.

The battery contains 276 cells of Pollak's type, of a normal capacity of 920 ampere-hours at one-hour discharge. The battery is intended as a buffer to equalise the tramway load, and also to run up the motor-generator to speed from the direct current side for synchronising. It is also useful as a reserve, it being capable of replacing a 500-KW. generator for a period of one hour. No battery switch or regulating cells are needed. Fig. 6 is a view of the battery room as seen from the entrance.

The pumping station at Albe Mainzergasse and the lifts of Messrs. Zönhold Söhne in Kaiserstrasse are interesting as examples of small single-phase motors working under conditions which should prove their value, and perhaps make them more popular for motor loads for single-phase systems in this country.

The order and cleanliness prevailing in these stations reflect great credit on the designers and engineers alike. The perfectly wholesome condition of the floors, and, in fact, the entire plant and buildings, are truly represented by the illustrations given with this description. The members of the I.E.E. left Frankfort last year with a feeling that they had seen a power and lighting system which might have been akin to many of our own early stations at the present time, but for the general tendency in England to add entirely new direct-current plant when the demand arises for a traction or heavy motor load.

ELECTRIC LIGHTING OF THE EMBANKMENT.

The electric lighting system of the Victoria Embankment and of Westminster Bridge, part of which was formally inaugurated by the L.C.C. last year, was recently completed and is now in full operation. The first instalment, as described in our pages at the time, was confined to the parapet, 6-ampere arc lamps of the open type being neatly adapted to the existing and artistic standards formerly devoted to gas lighting. The roadway is now illuminated with a row of 12-ampere lamps along either side, pendant from graceful standards similar to the one near the Houses of Parliament, which we illustrate. The lamps, raising gear, &c., were designed, made and erected by the Gilbert Arc Lamp Company, Limited, of Chingford.

A special feature of the work is the extraordinary length of carbon used—no less than 6 ft. in each lamp—in this case, as in most of the public lighting installations carried out by this firm. In spite of this fact, the appearance of the lamp, together with the contact hood containing the raising gear, is extremely neat and well proportioned.

The raising gear, which we recently examined, is exceptionally strong, and embodies several new features; the lamp is suspended by two stout steel cords, so that it cannot twist, and it is impossible for it to get out of control and fall. Contact is made by means of spring plungers with long travel.

Objection is often raised to double carbon lamps because of their supposed complication; this, however, cannot be averred against the Gilbert lamp, the working parts of which are extremely simple, and few in number. The advantages derived from the increased number of hours of burning, which works out to nearly double that obtained from most lamps, are obvious and important, a considerable economy in labour resulting therefrom. The successful results obtained from these lamps are a sufficient testimony to their practicability and reliable working.

A point worthy of note is the ingenious manner in which various existing gas lanterns and standards have been rearranged and adapted so as to make admirable arc lamp carriers; this is rendered possible by the shortness of the lamps, and it is found that in many cases the result could not be improved upon by a special design for the purpose. The Westminster Bridge lanterns and the triple standard in Northumberland Avenue are particularly good examples of this arrangement, which might well be borne in mind in similar cases elsewhere.

Thames Embankment: Arc Lamp Standard.

Aberdeen Telephones.—The T.C. has confirmed the recommendation of the Telephone Committee to apply for a municipal license.

FORTHCOMING EVENTS.

Friday, March 14th.—At 9 p.m. Royal Institution. Discourse by Prof. Silvanus P. Thompson on "Magnetism in Transitu."

At 8 p.m. Institution of Junior Engineers. Meeting at the Westminster Palace Hotel. Paper on "The Uses of Engineering Models," by Mr. Percival Marshall.

At 5 p.m. Physical Society. Meeting at the rooms of the Chemical Society, Burlington House. Papers on "The Thermal Expansion of Porcelain," by Mr. A. E. Tutton; "On the Temperature Variation of the Electrical Resistance of Pure Metals, and Allied Matters," by Mr. W. Williams; "A Suspected Case of the Electrical Resonance of Minute Metal Particles for Light Waves. A new type of Absorption," by Prof. R. W. Wood.

Saturday, March 15th.—Institution of Junior Engineers. Conversazione at the Westminster Palace Hotel. Reception at 7 p.m.

At 3 p.m. Royal Institution. The Right Hon. Lord Rayleigh on "Some Electrical Developments." (Lecture V.)

At 8 p.m. New Electrical Wiremen's Association. Smoking Concert at the "Alma," Parson's Green Lane, Fulham.

Tuesday, March 18th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester Section). Meeting at Owens College. Paper on "Some Points in the Equipment of Electrical Tramcars," by W. G. Rhodes.

At 8 p.m. Institution of Civil Engineers. Meeting. Paper to be further discussed: "Electrical Traction on Railways," by W. M. Mordey and Bernard M. Jenkin. The following paper will afterwards be read: "Subaqueous Tunnelling through the Thames Gravel: Baker Street and Waterloo Railway," by Arthur H. Haigh.

Wednesday, March 19th.—At 7.30 p.m. Institution of Electrical Engineers (Birmingham Section). Meeting in the Physics Theatre of the University. "Tests on the Nernst Lamp," by R. P. Hulse.

At 7.30 p.m. Institution of Electrical Engineers (Students' Section). Meeting in the Library of the Institution. Paper on "Electric Cranes," by J. C. Smail.

At 8 p.m. Society of Arts. Meeting. Paper on "Electric Traction. London's Tubes, Trams, and Trains," by J. Clifton Robinson.

At 2.15 p.m. Institution of Civil Engineers. Students' visit to the Incandescent Electric Lamp Company's works at Brook Green, Hammersmith.

Thursday, March 20th. — Institution of Electrical Engineers, London. (See our "Notes" columns to-day.)

Friday, March 21st.—At 8 p.m. Institution of Mechanical Engineers. Meeting. Papers to be read and discussed:—"Fencing of Steam and Gas Engines," by Mr. H. D. Marshall; "Fencing or Guarding Machinery used in Textile Factories." by Mr. S. R. Platt; "Protection of Lift Shafts, and Safety Devices in Connection with Lift Doors and Controlling Gear," by Mr. H. C. Walker; "Guarding Machine Tools," by Mr. W. H. Johnson.

Monday, March 24th.—Institution of Electrical Engineers (Newcastle Section). Meeting. Paper on "The Distribution of Flux in Large Electro-Magnets," by W. M. Thornton.

At 8 p.m. Institute of Marine Engineers. Meeting at 58, Romford Road. Paper by Mr. H. M. Rounthwaite on "Balancing Engines."

NOTES.

Tunbridge Wells Telephones.—The Local Government Board inquiry closed on Friday last. We publish to-day an instalment of the evidence. We shall complete the report in our next week's issue, reserving any comment until then.

National Electrical Manufacturers' Association.—A number of influential firms in the electrical trade have recently decided to form, under the above title, an association for the purpose of protecting their interests, and, at the same time, of dealing with questions affecting the industry generally. The Association's aim will be to place the various sections of the electrical trade on a sound, commercial, and competitive footing, without antagonism towards existing trade associations or institutions. We learn that Mr. Walter Davenport, who holds a similar position in connection with several other important associations, has been appointed secretary, and his address is Ridler Place, Holland Street, Blackfriars, S.E.

Breakdowns of Electrical Machinery.—At the annual meeting of the Engine Boiler and Employers' Liability Insurance Company, of Manchester, Mr. R. B. Longridge, the chairman, in referring to the work of the electrical department during last year, said (according to the *Mechanical Engineer*) that they deemed it advisable to carry forward a larger balance than usual to the next account in view of the numerous claims for damage to electrical machines. It would be interesting, and perhaps surprising, to learn that one out of every nine machines insured by the company had broken down during the past year. A large portion of the mishaps had occurred through the ignorance or carelessness of the attendants who were not electricians. In these cases he was pleased to say that the utility and educational value of the frequent visits of the company's inspectors were being felt and appreciated by the employers. Even where trained electricians were in attendance, numerous "breakdowns" had occurred through lack of attention to cleanliness, which is so essential to the safety of electrical machines. On the whole, notwithstanding the unfavourable experience of the past, he was gratified to know that considerable economy in the upkeep of machines had been effected, and he confidently looked forward to a steady diminution of the company's losses by means of a careful system of efficient inspection.

High-Pressure Transmission of Energy on the Continent.—It is well known that high voltage currents have been in use for years in the United States for long-distance transmission of energy. Some of the plants, where the climate is very favourable, have adopted pressures up to 40,000, and even 50,000 volts. On the Continent, where hydraulic energy in the immediate vicinity of industrial centres is becoming more and more scarce, long-distance power transmission with high voltage is being frequently resorted to, as the following will show:—A 37 km. transmission at 20,000 volts is being constructed to supply Como with energy. In the vicinity of Zaragoza, in Spain, two plants of 4,000 and 6,000 H.P. respectively are being installed. The power obtained will be transmitted at 30,000 volts over a distance of 45 and 80 km. The Fure and Morge installation, near Grenoble, in France, is a 7,000-H.P. plant, supplying current at 26,000 volts to a number of towns and villages, such as Voiron, Moirans, &c., the distance covered being 50 km. This plant has been completed, and is now working. The Beznau plant near Waldshut provides 10,000 H.P., and the current is sent over distances up to 60 km., at a voltage of 25,000. Lastly, an order has recently been placed for the machinery of a 13,000-H.P. plant to be erected on the Cellina river in Northern Italy, the energy being supplied at a pressure of 36,000 volts, to the towns of Venice, Udine, Pordenone, &c. Current in this installation is transmitted over distances up to 90 km. In all the above plants the current is three-phase, and is generated at a comparatively low pressure of a few thousand volts, and raised to the transmission voltage by means of stationary transformers. The electrical machinery for all the above plants will be, or has been, supplied by the well-known firm of Brown, Boveri & Co., Limited, of Baden, Switzerland, who seem to be making a speciality of this kind of work.

L.C.C.—At Tuesday's meeting Mr. R. Cousins—on the motion for the reception of the report of the Highways Committee—asked the chairman whether the tender of Messrs. Maclellan, which was recently accepted for the supply of Belgian rails, had fulfilled the conditions of the Council's standing orders specifying the rates of wages and hours of labour to be observed by the contractor, and if so, whether he would place the information before the Council. Mr. J. W. Benn, in reply, remarked that the Council could procure the same conditions with regard to the manufacture of the rails in Belgium as would obtain supposing the rails were made in Scotland. He had read out the previous week the clause relating to the question, and then informed the Council that as the tender was sub-let the Council could put into the contract any form of words for the protection of those who made the rails. Therefore the usual words would appear in the contract, and the clause would secure that the prices paid for labour were those which obtained in the district as between employers and workmen. The exact rate of wages was not stated in the tender, but there would be no difficulty in the contract now being prepared in obtaining ample protection. There was no reason why the rate of wages and hours of labour should not be stated, but they would be the same as those prevailing in the district.

The Highways Committee.—The constitution of this Committee, which is entrusted with the consideration of all electrical matters, was fixed as follows for the ensuing year:—J. A. Baker, R. M. Beachcroft, J. W. Benn, E. Browne, Sir J. Dickson-Poynder, N. W. Hubbard, W. C. Johnson, Sidney Low, M. Mayhew, R. Parker, Hon. W. R. W. Peel, R. C. Phillimore, D. S. Waterlow, T. Wiles, and T. McKinnon Wood.

Electric Clocks.—The Glasgow Corporation are now fitting up at various public crossings, &c., six of Prof. Becker's new electric clocks. They will be controlled from the Glasgow Observatory, and will each have a 2 ft. dial. The dials will in each case be fixed to one of the street electric lighting pillars.

Institution of Electrical Engineers.—In the event of the discussion on the shock papers being finished last night, the paper down for consideration at the next meeting of the Institution of Electrical Engineers is to be "Problems of Electric Railways," by Mr. J. Swinburne and Mr. W. R. Cooper.

The Engineering Dispute.—A Stockton correspondent of the *Financial Times* states that in the monthly report of the Amalgamated Society of Engineers, issued on Saturday, the secretary (Mr. G. N. Barnes) reports that a conference had been held with the Employers' Federation executive in regard to the new agreement rejected by the men. The employers expressed surprise that the men had not accepted it, and their opinion that this was due to a misapprehension. The discussion had, however, yielded nothing beyond an interchange of views, and a general agreement to open up communications again, if either side had any suggestions to offer to meet the difficulty.

Obituary.—It is with sincere regret that we have to record the sudden death which occurred at Brussels on the 4th inst., of Mr. Bryan Donkin. Mr. Donkin, whose name is a household word in engineering circles all over the world came of an engineering stock. Born in 1835, he was the son of one who in a very short life accomplished great things in the field of mechanical science. From the *Times* notes we gather that the late Mr. Donkin was educated at the University College, London, and passed through an engineering course at the Ecole Centrale des Arts et Metiers in Paris, and he was afterwards apprenticed at the Bermondsey works. In 1861 he became a partner in the Bermondsey firm, which in 1889, was made into a limited company, and about two years ago an amalgamation was effected with an engineering company at Chesterfield. His work covered a very wide field of engineering research, the improvement of the steam engine and the invention of his steam revealer being among his chief achievements. He investigated the manner in which heat is transmitted through the metallic wall of a cylinder, conducted elaborate tests with steam boilers, and was also an authority on the gas engine and on motor car matters. To us Mr. Donkin's death is a matter for more than ordinary regret, for it had been a pleasure to us to know him as a valued contributor to the columns of the Electrical Review during the past few years.

We also regret to announce the death of Mr. James Dick, of the well-known Glasgow firm of R. and J. Dick, gutta-percha and rubber manufacturers. His death occurred on the 7th inst. at the age of 77 years. A point of interest that may be mentioned is that in the course of his career he had carried out large contracts in connection with the manufacture of deep-sea cables.

Personal.—At the monthly meeting of the Birkenhead Town Council last week, the salary of Mr. A. R. Fearnley, tramways manager, was increased from £300 to £450 per annum.

Mr. Suntly, of Birmingham tramways, has been appointed manager of the new electric tramways of Wolverhampton, at a salary of £250 per annum.

Mr. J. B. Hamilton, for some time chief traffic manager of the Glasgow tramways, was last week appointed to the position of tramways manager to the Leeds Corporation, at a salary of £900.

An interesting presentation was made at Wolverhampton by the staff, foreman and workmen of the Electric Construction Company, Limited, Bushbury Engineering Works, on Friday, March 7th, to Mr. A. B. Blackburn, late manager of the company, whose resignation has already been announced in these columns. The presentation consisted of a handsome solid silver salver and coffee service and a gold combination watch and sovereign case.

Appointments Vacant.—Borough electrical engineer for Middlesbrough, at £250; superintendent of overhead construction on electric tramways (Halifax Corporation), at £150. The Johannesburg Municipality wants an engineer to report upon a proposed scheme for the reorganisation and extension of its electric light and power station and construction of tramways. The scheme will involve an expenditure of between £300,000 and £400,000. See our "Official Notices" to-day.

Big Boiler Contract.—It is announced that a contract for 48 boilers has been placed with Messrs. Babcock & Wilcox by the Metropolitan District Traction Company in connection with the electrification of the underground railways. The amount of the contract is given as £60,000.

Bath Electric Lighting.—The City Council, sitting as an Electric Lighting Committee, on Tuesday discussed at great length the recommendations made to them by the Inquiry Subcommittee as to the electric lighting undertaking. They recommended an expenditure of £13,000 to place the works in a condition to face next winter's load, and asked that they might be authorised to receive and consider tenders for the leasing or sale of the works. The report was adopted.

Information Wanted.—A correspondent wants to know the address of a chemical factory in Ireland, near Dublin, Cork or Limerick, providing pure sulphuric acid which can be used for accumulators.

Interchangeable Work and Foreign Errors.—While we would not for a moment decry the value of interchangeable work—indeed, we write this to emphasise its value—we are almost daily reminded that the systematic abuse of British engineering to which we have been accustomed of late years for the purpose of pushing the interests of foreign work, has little foundation in fact, and might better be applied to foreign products. Only recently we had our attention called to some American productions that, while professing to be made on thorough American principles of interchangeableness, were absolutely otherwise. Again, we were shown some products from a high-class German shop that were not even a pretence of a fit. Both in make and in inspection we are constantly being shown omissions and errors which convince us that with all the loud shouting there is a lack of perfection in detail, design and inspection in foreign productions that should encourage our own manufacturers to continue their efforts to improve in full confidence that they are fully even in the race. Such perfection has been claimed for the foreigner, that his customers feel all the worse disappointment when he proves so seriously at fault.

Bermondsey Exhibition.—We regret that in our notice of the above last week, we overlooked the exhibit of the General Electric Company (1900), Limited. This was the largest in the hall, and contained samples of everything likely to attract the consumer in the way of lighting, heating, and power, fittings of all sorts, cooking apparatus, radiators, switchboards, electric fans, and small motors, besides a large display of electric bells and telephones. The company also exhibited a selection of Coronation devices. At a separate stand, one of their operators from the "Robertson" Lamp Works was busy making "Robertson" lamps, the process being shown in all its various stages; this stand was the only one where incandescent lamps were being made, contrary to our statement last week. Outside the Hall there was a large illuminated sign advertising the exhibition, consisting entirely of "Robertson" lamps.

THE CENTRAL STATION ENGINEER.

The Crown Agents for the Colonies, through their consulting engineers, Messrs. Preece & Cardew, have appointed Mr. Alf. T. Yates as assistant electrical engineer at Gibraltar. Mr. Yates was educated at Dulwich College, and was subsequently thoroughly trained as a mechanical engineer. In 1899 he joined the staff of the City of London Electric Lighting Company, Limited, and for some time past has held the responsible position of engineer-in-charge at Bankside, where he has earned the respect and esteem of all those with whom he has been brought in contact. He takes up his new appointment at the beginning of April.

Mr. H. W. Clayden, the borough electrical engineer, Middlesbrough, has resigned his position, having accepted the appointment of engineer to the Consolidated Main Reef Mines in South Africa.

The Council granted an increase of salary to Mr. J. B. Hudson, outside assistant to the Bootle Corporation, from £2 5s. to £2 10s. per week.

The Corporation of Dublin has increased the salary of the city electrical engineer, Mr. Mark Ruddle, from £375 to £450 per annum.

The Manchester City Council has advanced the salary of the chief engineer, Mr. G. F. Metzger, from £800 to £900 per annum. Other officials have also received advances.

At the Liverpool City Council last week, Mr. Alfred Clough, lately assistant electrical engineer at a salary of £600 per annum, was appointed deputy electrical engineer at a salary of £700 per annum, the appointment to date as from February 1st, 1902. Mr. Wm. H. Collis, lately distribution engineer at a salary of £350 per annum, increasing on April 1st, 1902, to £400, was appointed as from February 1st, 1902, assistant electrical engineer at a salary of £450 per annum.

NEW COMPANIES REGISTERED.

Electric Laudaulet Company, Limited (72,890).—This company was registered on February 24th, with a capital of £50,000 in £1 shares, to manufacture, sell, let on hire, maintain, repair, clean, store, and generally deal in and with and act as jobmasters in connection with cycles, carts, cabs, carriages, vans, wagons, boats, launches, flying machines, and vehicles of all kinds, whether driven by human, animal, electric, hydraulic, pneumatic, steam, or other power, to manufacture and deal in apparatus, tools, and accessories for the same, to train, equip, and hire out chaffeurs, engineers, motor and other vehicle drivers, cleaners, repairers, &c., and to carry on the business of electricians, mechanical engineers, machinists, fitters, founders, smiths, tube makers, rubber manufacturers, ironmongers, platers, &c. The first subscribers (each with one share) are:—G. T. Seagrave, 69, Falkland Road, N., accountant; H. H. Fox, 2, Brick Court, Middle Temple, E.C., solicitor; J. B. Taylor, 212, Brecknock Road, N.W., clerk; F. W. Sumpster, 35, Arundel Square, N., clerk; E. Wallace, 56, Mornington Road, N.W., law stationer; J. P. Eldridge, 16, Marlborough Road, Bowes Park, N., shorthand writer; and W. H. Woodrow, Fern Bank, Florence Road, Stroud Green, N., clerk. No initial public issue. Registered without articles of association.

Barnsley and District Electric Traction Company, Limited (72,962).—This company was registered on March 3rd, with a capital of £50,000 in £5 shares, to carry on the business of carriers of passengers and goods, electrical and mechanical engineers, electricians, engineers, contractors, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic and other apparatus, generators, accumulators, transmitters, users and suppliers of light, heat, sound and power by electricity, galvanism, magnetism, compressed air, gas, steam, oil or other means, manufacturers of plant and machinery, constructors or owners of railways and tramways, &c. The first subscribers (each with one share) are:—E. Garcke, Donington House, Norfolk Street, W.C., managing director; T. E. Pilkington, Chevet Park, Wakefield, baronet; W. Greer, 58, South Eaton Place, S.W., director; E. A. Paris, Cross Trees, Gomersal, director of a public company; E. Hopwood, 35a, Hereford Street, Mayfair, W., secretary; H. A. Stagg, 96, Buckingham Palace Road, S.W., clerk; and C. H. Godward, 198, Park Road, Crouch End, N., secretary. No initial public issue. The number of directors is not to be less than three nor more than seven: the subscribers are to appoint the first; qualification, one share; remuneration, £50 each per annum, and 5 per cent. of the dividend on the ordinary shares, divisible (no division of original capital into preference and ordinary shares specified). Mention is made of possible agreements with the British Electric Traction Company, Limited. C. H. Godward is the secretary. Registered office, Donington House, Norfolk Street, W.C.

Albion Battery Company, Limited (72,956).—This company was registered on March 1st, with a capital of £25,000 in £10 shares, to acquire any patents, rights or inventions relating to the production, treatment, storage, distribution and use of electricity, in particular to acquire from C. T. J. Oppermann, G. Fowler and R. G. Margetson the benefit of certain existing inventions relating to the manufacture, application and use of electrical accumulators, and to carry on the business of electrical and mechanical engineers, manufacturers of, and dealers in, electric, magnetic, telegraphic, telephonic and other appliances and apparatus, &c. The first subscribers (each with one share) are:—I. I. Edwards, 11, Gray's Inn Square, W.C., solicitor; E. H. Holme, Suffolk Street, Pentonville, N., manufacturer; C. T. J. Oppermann, 57, Wray Crescent, Tollington Park, N., electrical engineer; W. E. Keymer, The Limes, Old Charlton, gentleman; W. Evans, 21, Albert Street, Regent's Park, N.W., gentleman; T. H. Batstone, Pheasantfield, Willesden Green, N.W., gentleman; G. Fowler, Portland Hotel, W., gentleman; R. G. Margetson, 76, Great Portland Street, W., gentleman; and A. M. Broadley, The Knapp, Bradpole, Bridport barrister. Minimum cash subscription 50 per cent. of any shares first offered to the public. The number of directors is not to be less than three nor more than five; the first are C. T. J. Oppermann, G. Fowler and R. G. Margetson; qualification, £100.

Nernst Electric Light, Limited (62,807).—This company's annual return was filed on January 16th, when 139,480 preference, and 180,000 ordinary shares were taken up (in addition to 520 since forfeited, and now the property of the company) out of a nominal capital of £320,000 in 140,000 preference and 180,000 ordinary shares of £1 each. £1 per share has been called up on 115,000 shares, resulting in the receipt of £114,718 15s. £281 5s. remains in arrears. 180,000 ordinary and 25,000 preference shares are considered as fully paid. £238 15s. has been paid on the forfeited shares. No mortgages or charges.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

D.P. Battery Company, Limited.—Particulars of registered mortgages and charges:—Total amounts secured by series of debentures: £20,000 first debentures and £5,000 second debentures. Dates of resolutions creating first debentures: November 15th, 1898, and October 16th, 1901. Date of resolution creating second debentures: May 30th, 1899. Date and amounts of present issues: October 29th, 1901, £10,000 first debentures and £500 second debentures. Property charged: First debentures—all real and personal property, present and future, and the undertaking, goodwill and business of the company, including uncalled capital; second debentures—a second charge on above-mentioned property. No trustees. Amounts previously issued of same series: £5,000 first and £5,000 second debentures, the issue of second debentures on October 29th, 1901, being two debentures of £250 each to replace one debenture of £500 now cancelled.

African Trans-Continental Telegraph Company, Limited.—This company's annual return was filed on February 10th, when 170,300 shares were taken up out of a nominal capital of £300,000 in 300,000 shares of £1 each. £1 per share has been called up, and £169,305 has been received. £995 remains in arrears; £10 has been paid on 20 shares forfeited; no mortgages or charges.

British Westinghouse Electric and Manufacturing Co., Ltd.—This company's annual return was filed on December 20th, when 150,000 preference and 75,000 ordinary shares were taken up out of a nominal capital of £1,750,000 in 200,000 preference shares of £5 each, and 75,000 ordinary shares of £10 each. £5 per share has been called up on the preference shares, resulting in the receipt of £750,000; £750,000 is considered as paid on the ordinary shares; no mortgages or charges. Note.—A prospectus filed subsequently to above return offered £500,000 4 per cent. mortgage debenture stock for subscription.

Electric Railway and Tramway Carriage Works, Limited (57,082).—Particulars of registered mortgages and charges.—Date of trust deed: November 28th, 1901. Total amount secured: £50,000 debenture stock. Property charged: Five plots of land, containing about 60,170 square yards, held for residues of five several terms of 999 years, at Strand Road, Preston, Lancs., and the buildings and works erected thereon, and fixed and loose machinery therein, known as the Electric Railway and Tramway Carriage Works, with certain rights and privileges annexed to such land, and all assets for the time being of the company, both present and future, including uncalled capital. Trustees: John E. Prestwich, of Farnworth, near Bolton; and Thomas S. Turnbull, of 13, Spring Gardens, Manchester. Date of registration: December 6th, 1901.

SUPPLY STATION ACCOUNTS.

Croydon Corporation Electricity Accounts.

The growth of the Croydon Corporation electricity supply is still maintained, and lamps are being added at the rate of about 12,000 per annum. The capital expenditure is not yet fully employed, many of the mains being only lightly loaded, and at the present time the mains, &c., have cost more than £60 for each consumer connected. Although the inevitable rise in costs is shown, due to the high price of coal in 1900, this is not appreciably added to by other items. The revenue per unit, however, having fallen, the net profit is less than before.

General Statement.

	1899.	1900.	Inc.
Total capital expenditure ...	£117,385	**£171,291**	£53,906
Number of units sold	781,291	**1,074,655**	293,364
No. of 30-watt lamps connected	45,122	—	—
Maximum load in KW.	714	**922**	208
Gross revenue	£13,468	**£18,129**	£4,661
Gross expenditure...	£6,751	**£10,170**	£3,419
Gross profit	£6,717	**£7,959**	£1,242
Average price per unit sold ...	3·96d.	**3·84d.**	−·08d.

In the revenue account credits are shown for non-delivery of plant to time; thus the Thomson-Houston Company paid £100, the Babcock-Wilcox Company £300, in each case for generating plant, and the former also were penalised in the sum of £20 for late delivery of transformers. These payments explain the slight increase in revenue in the last item below, and tend to reduce the drop which has taken place in the receipts from energy sold. The public lighting now includes 162 arc lamps and 22 incandescents.

Revenue Statement.

	1899. Gross.	Per unit.	1900. Gross.	Per unit.	Inc.
Sale of energy	£12,884	3·96d.	**£17,221**	3·84d.	−·12d.
Meter rents	341	·11d.	**476**	·11d.	·00d.
Sale of old material and work done.	—	—	**5**	·00d.	·00d.
Sundry fees, refunds by contractors, &c.	243	·07d.	**427**	·10d.	+·03d.
Gross revenue ...	£13,468	4·14d.	**£18,129**	4·05d.	−·09d.

In the costs "coal" exercises most influence as the figure has run up considerably over one penny per unit. The largest reduction is in "wages," but this is more than balanced by the increase in "salaries." The other items are practically unaltered. The total cost now stands at slightly over 2¼d. per unit.

Cost of Production.

	1899. Gross.	Per unit.	1900. Gross.	Per unit.	Inc.
Coal..	£3,145	·96d.	£5,057	**1·13d.**	+·17d.
Oil, waste, water, and engine room stores.	322	·10d.	498	**·11d.**	+·01d.
Salaries and wages incurred in generation and distribution, and attending public lamps.	1,253	·39d.	1,490	**·33d.**	−·06d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c., and street lamps.	451	·14d.	669	**·15d.**	+·01d.
Works cost ...	£5,171	1·59d.	£7,714	**1·72d.**	+·13d.
Rent, rates and taxes ..	205	·06d.	336	**·07d.**	+·01d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	967	·30d.	1,643	**·37d.**	+·07d.
General establishment charges, stationery and printing, law charges and insurance.	408	·12d.	477	**·11d.**	−·01d.
Other expenses	—	—	—	—	—
Total costs ...	£6,751	2·07d.	£10,170	**2·27d.**	+·20d.

The gross profit has increased by £1,242, but financial charges absorb an additional £1,725. The difference between these two amounts, therefore, has reduced the net profit of £941 by £483 to £458. Of this sum £8 goes to provide for future bad debts, and £450 is carried forward.

Profit Statement.

	1899.	1900.
Interest on loans	£3,014	£5,387
Sinking fund for repayments	2,762	2,114
Net profit carried towards bad debts 1901	—	8
Net profit carried forward	941	450
Gross profit	£6,717	£7,959

Blackpool Corporation Electricity Accounts.

The accounts of the electricity department of the Blackpool Corporation for 1901 did not come up to the position expected. Increased costs per unit, and diminished revenue, have led to a retrograde movement in the profits. The capital expenditure is proceeding more rapidly, and this is accompanied by a larger increase in the output, indicating that the business has abundant room for expansion, and we trust that this expansion will be concurrent with payment of all the financial charges. The position attained is shown by the following figures:—

General Statement.

	1899.	1900.	Inc.
Total capital expenditure ...	£118,535	**£146,085**	£27,550
Number of units sold	1,148,564	**1,515,866**	366,802
Number of lamps connected ...	78,000	—	—
Maximum load in kilowatts ...	1,300	**1,460**	160
Gross revenue	£18,498	**£23,530**	£5,032
Gross expenditure	£10,535	**£16,185**	£5,650
Gross profit	£7,963	**£7,345**	−£618
Average price per unit sold ...	3·56d.	**3·36d.**	−·20d.

1,760,459 units were generated, and 1,515,366 units were sold, distributed as follows:—

Year.	1898.	1899.	1900.
Private units	523,412	726,860	858,415
„ rates charged	8d., 5d., 2½d., and 2d.	8d., 7d., and 2d.	7d., 5d., 2½d., and 2d.
Public units	164,922	193,053	264,754
„ rates charged...	8d. and 2d.	8d., 7d., and 2d.	7d. and 2d.
Tramway units ...	181,850	228,651	392,197
„ rates charged	2d.	2d.	2d.

Public lighting now represents 260 10-ampere arcs and 290 8-c.p. incandescents, or increases of 60 and 26 respectively, while private consumers have increased from 900 to 910 in number. The length of mains is about 80 miles. The revenue account shows an increase of £5,032 in the gross, but the average receipts have fallen just over ½d. per unit., and now stand under 2¾d.

Revenue Statement.

	1899. Gross.	Per unit.	1900. Gross.	Per unit.	Inc.
Sale of energy	£17,055	3·56d.	**£21,186**	3·36d.	—·20d.
Meter rents	—	—	—	—	—
Sales of material and attendance to public lamps.	1,372	·29d.	**1,437**	·23d.	—·06d.
Sundry fees, premiums, rent, and interest on capital expended on public lighting.	71	·01d.	**907**	·14d.	+·13d.
Gross revenue ...	£18,498	3·86d.	**£23,530**	2·73d.	—·13d.

In the last three years coal has been rising persistently. In 1898 it was ·55d. per unit, and now is 1·22d., or more than double the figure two years ago. Similarly "repairs" have shown an upward tendency, and as these increases have not been met by serious reductions in other items, the works costs are now 2¼d., and total costs over 2½d. per unit. But for Blackpool, with its peculiar load factor, the figures are not unsatisfactory even as they now stand.

Cost of Production.

	1899. Gross.	Per unit.	1900. Gross.	Per unit.	Inc.
Coal, and unloading same ..	£3,353	·70d.	£7,697	**1·22d.**	+·52d.
Oil, waste, water, and engine room stores and carbons.	1,101	·23d.	1,341	**·21d.**	—·02d.
Salaries and wages incurred in generation and distribution, attending street lamps	2,086	·44d.	2,332	**·37d.**	—·07d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c., public lamps.	1,961	·41d.	2,820	**·45d.**	+·04d.
Works costs	£8,501	1·78d.	£14,190	**2·25d.**	+·47d.
Rent, rates and taxes ..	478	·10d.	489	**·08d.**	—·02d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	974	·20d.	933	**·15d.**	—·05d.
General establishment charges, stationery and printing, law charges and insurance	542	·11d.	385	**·06d.**	—·05d.
Other expenses: Contribution to hospital and loss on sale of property.	40	·01d.	188	**·02d.**	+·01d.
Total costs ...	£10,535	2·20d.	£16,185	**2·56d.**	+·36d.

The profits have been changed into losses by the reduction of the gross profit by £618, and augmented financial charges of £763. These two taken together, swallow up the previous net profit of £1,176, and leave a net loss of £205.

Profit Statement.

	1899.	1900.
Interest on loans	£6,787	£4,270
Sinking fund for repayments		3,280
Net profit carried forward..	—	—205
" " to credit of rates	1,176	—
Gross profit	**£7,963**	**£7,345**

CITY NOTES.

Kensington and Knightsbridge Electric Lighting Company.

Sir F. J. Bramwell presided at the ordinary general meeting of the proprietors of this company, held on Wednesday, March 5th, at 5, Great George Street, Westminster, S.W. In moving the adoption of the report, he referred to the death of Mr. Granville Ryder, who had presided over the affairs of the company since its commencement. They had also lost by death Mr. Bolton, who had been a director of the company almost from its inception. To fill the vacancies on the board the directors had elected Mr. Hopkinson and Colonel R. Crompton. Turning to the accounts, the chairman said it would be noticed with satisfaction that the company had increased its number of consumers to 2,605, with a corresponding increase in the number of lamps to 222,158. Although the Wood Lane works were not part of their undertaking, yet many of them were individually interested in it, and the shareholders would be glad to know that it had supplied the company with a large portion of electricity. The well-being of that station was therefore a matter of importance to them, and he might tell them that it was now working with complete satisfaction. They had certain property in the Brompton Road surrounding their station there, which it had been necessary to hold under a lease in order to protect themselves against any actions in respect of nuisance, and the opportunity having presented itself, the company had purchased the freehold. He wished to comment upon the excessively heavy rating during the year which had been imposed for parochial purposes, the charges made being, he thought, something dreadful.

Sir Charles Grant seconded the motion.

Mr. Albright said he had hoped to have heard from the chairman some explanation of what appeared to him to be the most disastrous report the company had ever presented since its inception. In the early days they had seen the company advancing, and now, for the first time in its history, they observed a backward movement, which was a most unfortunate state of things. No reason had been given for the decrease in the dividend from 12 per cent. to 10 per cent. There was also a reduction in the amount carried forward of about £2,900. He noticed that last year there had been an increased sale of 428,000 units which had cost the company £2,315 to produce, but in accordance with the previous year's working should have cost £2,880, which showed there had been a slight saving.

A Shareholder wished to know if the Wood Lane works were going to supply the company entirely with electric current.

The Chairman, in reply, said he doubted that. In answer to Mr. Albright he said it must be remembered that the company had had to raise capital which had been provided on the condition that it would be repaid by degrees year by year, and that to a large extent they had at present to face. The expenses of their generating station during the year had been very heavy, but during the last half of the year they had been far less, and he trusted that next year the rate of cost per unit would be greatly diminished. One of the reasons for the decrease in the dividend was the extra cost of the station, and another that they had had an increased capital of ordinary shares of £30,000 during the year, and now their capital was divided into three classes—ordinary shares, preference shares of two kinds, 5 per cent. and 6 per cent., and borrowed money 4 per cent.

The report was adopted, and the directors who retired by rotation were duly re-elected.

Windsor Electrical Installation Company.

The sixth ordinary general meeting of the above company was held at Windsor on March 5th.

Mr. Drury-Lavin, the chairman, presided, and in moving the adoption of the reports and accounts, congratulated the shareholders that they were able to maintain the dividend of 8 per cent. notwithstanding that 1901 had been a dull year for trade generally, but they anticipated a most prosperous year in front of them. The directors have decided to reduce the price of current from 4d. to 3d. per unit.

The report and accounts were approved and unanimously adopted.

The directors' report read as follows:—

The company's business continues satisfactory. The number of lamps and motors installed on December 31st, 1900, was equivalent to 17,808 of 8 c.p. During the year 4,881 were added, bringing the total to 22,689 at the end of the year 1901, of which 1,203 represent the motor power. The capital expenditure for the year amounted to £5,633 14s. 8d., bringing the total up to £59,303 18s. 1d. As usual, the principal expenditure has been on mains and machinery. Various small extensions have been made to connect up additional customers, and a new boiler and other plant have been added. The battery of accumulators which was provided the previous year has effected a considerable saving by supplying the day load, instead of the plant being run continuously. The net profit for the year is £4,350 11s. 11d., and the most gratifying feature of the accounts is the fact that £3,949 16s. 5d. of this has been derived from the supply of electricity. The profit on the installation department is only £400 15s. 6d., but the board believe that the carrying out of this class of work in Windsor and Eton at a reasonably low price benefits the lighting department, and the steady increase of previous years in the number of lamps connected has thus been maintained. The total amount of profit available for distribution, including the balance brought forward from the previous year, but allowing for interest on loans, is £4,763 16s. 1d. Out of this the directors recommend that the sum of £500 be added to the depreciation, renewal, and revenue fund, bringing it up to a total of £6,419 10s., and the shareholders will be asked to vote the usual sum of £350 for the directors' fees. The directors paid in September last an interim dividend of 2½ per cent., free of income-tax. They now recommend the declaration of a dividend of 5½ per cent., less income-tax, making, with the interim dividend already paid, 8 per cent. for the year. The total amount of capital expended exceeds the amount received from the issue of shares by £9,303 18s. 1d., and this has been met temporarily as shown by the balance-sheet. The directors do not consider that it would be advantageous to issue further shares at the present time, and they have, therefore, arranged for a loan up to the sum of £20,000 for five years, as required, at a low rate of interest. The directors retiring in rotation are Messrs. H. L. Prior and Edward Rilley, and being eligible, they offer themselves for re-election.

Cambridge Tramways Company.

The report of this company, which was adopted at the meeting last week, showed that Mr. P. W. Davies, of the B.E.T. Company, had been elected a director of the company.

The Chairman, in referring to the question of electric traction, gave a brief description of the Lorain surface contact system at Wolverhampton. He said that there was a great objection to the overhead trolley system in Cambridge, and the cost of the Lorain system was not more than for the trolley. He thought it was the very best system he had ever seen.

Some discussion followed as to whether the company was or was not under an absolute covenant with the B.E.T. Company.

The Chairman's reply was that there was an absolute agreement on certain conditions which never had been, and probably never would be, carried out. The company had hoped to get a long lease from the Corporation, and also permission to adopt electric traction, but this the Council refused.

Davis & Timmins, Limited.

The directors' report, to be submitted to the annual general meeting to-day at Winchester House, reads as follows:—

The directors beg to submit their report and the accounts for the year ending December 31st, 1901. The net profit for the year, including £1,990 17s. 11d. brought forward, after allowing for depreciation and commission to managers, is £11,764 18s. The interim dividend paid in September last on the preference shares absorbed £1,800, leaving a balance of £9,964 18s. to be dealt with, which the directors propose to appropriate as follows:—

To the payment of six months' dividend on the preference shares to December 31st, 1901 ..	£1,800 0
To the payment of a dividend at the rate of 8 per cent. per annum on the ordinary shares for the year ended December 31st, 1901	3,760 0
To be placed to general reserve	2,000 0
Leaving to be carried forward	2,404 18
	£9,964 18

Subject to the approval by the general meeting of the recommendations as to dividends, the warrants for both the preference and ordinary dividends will be posted to the shareholders on the 15th inst. The retiring director is Sir Henry C. Mance, who offers himself for re-election.

Metropolitan Electric Supply Company.

The report of directors to come before the meeting next Tuesday reads:—"The directors submit the following statement of the company's accounts for the year ending December 31st, 1901, prepared in the form prescribed by the Board of Trade under the provisions of the Electric Lighting Acts, 1882 and 1888. The capital expenditure, which at the end of 1900 amounted to £1,417,805 8s. 11d., has now reached a total of £1,619,731 2s. 8d., being an increase during the year of £201,925 13s. 9d. The principal items of expenditure were for the works at Willesden, and for the extension of the low tension system principally in Marylebone. The gross revenue for the year amounted to £235,741 18s. 11d. as compared with £209,420 6s. 1d. in 1900, being an increase of £26,321 12s. 10d. The cost of generation, which in 1900 was £106,009 4s. 9d., amounted in 1901 to £112,610 10s. 3d., or an increase of £6,601 5s. 6d. The generating plant at Willesden now consists of five machines of 1,500 KW. capacity each. In order to cope with the continued increase of business, two additional machines, each of 3,000 KW. capacity, have been ordered, one for delivery during the present summer, and the other in 1903. A Bill was introduced in the last session of Parliament to confirm a provisional order which had again been granted by the Board of Trade to the Borough Council of St. Marylebone, under which the Council were authorised to enter into a rate aided competition with the company. The directors opposed the Bill, and it was amended by placing the Borough Council under obligation to purchase the Marylebone portion of the company's undertaking and business, the operation of the order being suspended until the purchase has been completed. Provisions were also inserted to the effect that the purchase money and compensation to be paid to the company should, failing agreement, be determined by arbitration under the Lands Clauses Acts. The Bill, so amended, received the Royal Assent on July 26th, and notice to treat was served on the company by the Borough Council on November 1st. Steps are now being taken to have the purchase money and compensation determined by arbitration. In view of the probability of a re-arrangement of the company's capital becoming necessary on completion of the sale of the Marylebone portion of the undertaking, the directors have considered it better at present to provide for current capital requirements by obtaining temporary loans from the company's bankers than by the issue of new capital. The hearing of the arbitration under the terms of the London County Council (Improvements) Act, 1899, in connection with the compulsory acquisition by the Council of the generating works at Sardinia Street has been delayed by litigation, which has, up to the present, resulted in the company's favour. The County Council have, however, appealed to the House of Lords, whose decision is expected shortly. The balance at the credit of the revenue account, before providing for depreciation, is £91,061 6s. 9d. The directors have set aside £10,000 as an addition to the depreciation and reserve fund, which now amounts to £88,447 15s. 10d., carrying to the credit of the net revenue account (No. 5) the sum of £81,061 6s. 9d., which, with the balance brought forward from last account and other receipts, makes a total of £86,033 0s. 8d. After deducting interest on debenture stock and loans and other charges, there remains a balance of £36,044 12s. 8d. An interim dividend of 6s. per share on the ordinary share capital was paid on August 15th, 1901, amounting to £28,599 7s., and the directors recommend that a further dividend of 7s. per share on such shares be now paid, making a total distribution of 13s. per share for the year, being at the rate 6½ per cent. This will absorb a further sum of £35,000, and leave a balance of £1,044 12s. 8d. to be carried forward to next account. The directors consider that this result is satisfactory, having regard to the fact that the average price of coal for the year has been higher than in any previous year of the company's existence, and that the greater part of the capital expended during the year has not yet become remunerative. The number of 8-C.P. lamps supplied by the company increased during the year from 570,000 to 641,000. The present number of lamps connected is 654,000, and the applications show no signs of decrease. A report from the company's engineer is appended, showing that the stations, machinery and plant have been maintained in a satisfactory condition. In accordance with the articles of association the following directors, viz., John Verity, Esq., Frank Pailey, Esq., and W. Harrison Cripps, Esq., retire from the board, and are eligible and offer themselves for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., also retire, and are eligible and offer themselves for re-election."

Notting Hill Electric Lighting Company.

The twelfth annual report to December 31st, 1901, to be presented at next Tuesday's meeting, reads:—

"The expenditure on capital account, which at the date of the last balance sheet stood at £164,990 2s. 11d., has been increased during the past year by £31,489 18s. 4d., of which the principal items are:—

£15,258 17s. 6d. for new mains (principally the completion of trunk mains from Wood Lane to the distributing stations and distributors connected therewith).
£3,717 14s. 9d. for the leasehold property in Holland Mews (bought for the purpose of erecting a subsidiary station to supply the southern area) and freehold property adjoining the Victoria Gardens station.
£4,544 2s. 8d. for the erection of the buildings in Lancaster Road and Holland Mews to contain the transforming machinery, and
£6,161 1s. 3d. for the necessary machinery for equipping these stations.

"To provide the balance of capital necessary for this expenditure, 2,200 ordinary £10 shares were issued to the shareholders *pro rata*, at a premium of £2 per share. The following table shows the progress of the company:—

1891 ..	Lamps	6,056	..	Loss	£554 18 6
1892 ..	do.	9,438	..	Profit	112 6 1
1893 ..	do.	12,153	..	do.	1,481 7 1
1894 ..	do.	15,669	..	do.	2,101 17 8
1895 ..	do.	20,307	..	do.	3,227 14 10
1896 ..	do.	25,716	..	do.	4,736 9 8
1897 ..	do.	33,000	..	do.	6,854 1 2
1898 ..	do.	46,066	..	do.	7,251 13 7
1899 ..	do.	59,154	..	do.	10,360 17 4
1900 ..	do.	68,505	..	do.	9,856 0 0
1901 ..	do.	82,054	..	do.	13,046 4 9

"The number of consumers is now 1,445, and of these 93 per cent. are supplied at 200 volts. The profits of the company show an increase of 30 per cent. over those of last year, but owing to the large amount of additional capital expended on new works, not yet earning revenue but already ranking for dividend, the rate of distribution is lower than in 1900. The shareholders are aware that the directors are not responsible for the delay. It was due to the necessity of applying to Parliament for power to obtain a leasehold site, owing to the refusal of the freeholder to permit its transfer to this company. In May, 1901, terms were arranged by which the freeholder withdrew his opposition and the Bill became law on July 26th, 1901, too late, however, to permit of the works being completed before the winter period. The sub-stations, in Holland Mews in the south, and in Lancaster Road in the north, are complete, and arrangements are now made to run distributing mains as and where the demand for current arises. Under the powers granted by Parliament the freehold interest in the property in Bulmer Place adjoining the station, has been acquired. It will be recollected that this property was previously held on a short lease. The generating station at Wood Lane erected jointly by this company and the Kensington and Knightsbridge Electric Lighting Company, Limited, after being worked tentatively for the first few months of the year, is now supplying a large proportion of the current required by our company, the result being highly satisfactory. Joint debenture stock amounting to £115,000 has been issued to supply capital for this undertaking, and the cumulative sinking fund now amounts to £3,750 7s. 8d.

"Negotiations are proceeding with the Royal Borough of Kensington for supplying current for the purpose of street lighting. The premium arising from the issue of shares during the year amounted, after deducting expenses, to £4,330 15s. 8d., and this amount has been transferred to the depreciation, renewal and reserve fund, together with a sum of £250 received as a contribution towards an extension of a main and £1,419 4s. 4d. out of the net revenue, making a total of £6,000. In addition to this sum £907 16s. 3d. has been paid over to the trustees of the cumulative sinking fund of the Wood Lane joint debenture stock. From the remaining net profit is to be deducted the interest on the debentures amounting to £2,000, the interest on the Wood Lane joint debenture stock £1,593 9s. 5d., &c., leaving £7,281 3s. 1d. available for dividend. The preference shares have already received their full 6 per cent., and the directors now recommend the payment of the usual dividend of 6 per cent. on the ordinary shares, amounting together to £6,900, and the balance of £291 3s. 1d. will be divided, one-half being credited to the founders' shares undivided profit account and the remainder to the other classes of shares. An interim dividend of 3 per cent. was paid on July 1st, and the balance of 3 per cent. will be paid forthwith. The directors desire to place on record their appreciation of the services of the engineer and manager, secretary, and staff generally; the work in connection with the construction of the subsidiary stations has been very large, and has been ably carried out. The directors regret to announce the death of Mr. Alexander Howden, one of the original directors of the company, whose ripe experience and wide business knowledge contributed so greatly to its progress. To fill the vacancy thereby created, they elected Mr. William Henry Willans. The directors retiring in rotation are Sir William Crookes, F.R.S., and Mr. A. E. Franklin, who, being eligible, offer themselves for re-election. The shareholders' auditors, Messrs. Fox, Sissons & Co., retire, and being eligible, offer themselves for re-election. The accounts will be audited in due course on behalf of the Board of Trade."

Hove Electric Lighting Company.

The report of the directors, presented at the meeting at Salisbury House, London Wall, on March 12th, read as follows:—

The directors have pleasure in submitting the statements of account and balance sheet of the company for the year ending December 31st, 1901, from which it will be seen that the result of the year's working has again been satisfactory, the net profit having increased from £7,715 in 1900 to £8,282 in 1901. This profit would have been considerably larger, but for two items in the working expenses, which are unusually high this year. One is the increased cost of coal, the price of which, however, is now considerably reduced, and the other is the large increase in rates and taxes. The progress of the company is best shown by the following statistical table:—

Year.	Houses.	Equivalent to 8-c.p. lamps.	Units sold.	Gross revenue.	Net revenue.
1898	513	36,967	350,254	£9,480	£5,089
1899	671	44,824	444,499	12,070	7,097
1900	803	52,919	539,268	13,828	7,715
1901	921	61,366	629,427	15,519	8,282

To the net profit of £8,282 0s. 9d. there has to be added £272 8s. 3d. balance from the previous year, making a total of £8,554 9s. After deducting debenture interest paid and accrued, and the interim dividend at the rate of 7 per cent. per annum paid in October last, there remains a net balance of £5,437 1s 3d. to the credit of net revenue account. The directors propose to place £2,250 to the credit of the reserve fund, to declare a dividend, payable on April 15th next, at the rate of 9 per cent. per annum for the half-year on the share capital paid up, making with the interim dividend 8 per cent. for the year, and to carry the balance £453 19s. 11d. forward. During the past year the directors offered to the shareholders 1,000 additional shares at the price of £7 10s. per share. 745 of these were subscribed for, the premium realised being added to the reserve fund. With the addition now proposed to be made the sum at credit of the reserve fund will amount to £21,150 7s. The amount of £600 annually set aside for repairs and maintenance, in accordance with the contract with the Hove Commissioners, has again proved insufficient to meet the necessary outlay on this account during the year. As a result, the excess of £186 18s. 6d. has been taken from the maintenance reserve account, leaving a balance of £758 16s. 5d. The expenditure on capital account during the year has amounted to £9,215 7s. 6d., the total expenditure up to December 31st, being £109,738 11s. 3d. The directors intended to have had the erection of the new generating station well on towards completion by this time, but in consequence of delays and opposition on the part of the Corporation of Hove, the works could not be proceeded with. This opposition, however, is now at an end, and instructions have been given for commencing the construction at once. At the last general meeting, a shareholder put forward a proposal that the directors' fees should be increased, which was duly carried. The Chairman, however, considered that as no notice had been given of the motion, the matter should remain in abeyance until the next meeting, when the suggestion would be brought forward. The following resolution will accordingly be moved at the general meeting—"That the fees payable to the directors be increased to £150 each per annum, with £100 additional to the Chairman, to take effect from January 1st, 1901." In accordance with the articles of association, Colonel Henry Wood, C.B., retires from the board by rotation, but offers himself for re-election. Messrs. J. H. Duncan and Co., the auditors, also offer themselves for re-election.

The Chelsea Electricity Supply Company.

THE annual ordinary general meeting of the shareholders of the above company was held on Wednesday last week at the Chelsea Town Hall, Mr. J. Irving Courtenay presiding.

The CHAIRMAN, in proposing the adoption of the report, said it recommended a diminution in the dividend of 1½ per cent. on the dividend of last year, and a considerable increase on the amount placed to depreciation. He was aware that the shareholders were greatly disappointed at the reduction of the dividend, but he firmly believed that it would be for the ultimate benefit of the property. It was only after the most anxious and careful consideration that the directors decided that the position should be faced at once without waiting for a further increase in the amount of available profits. At an annual meeting some two or three years ago, he called attention to the question of depreciation and to the inadequacy of the sum set aside, and expressed a hope that they should soon, by reason of the increase in the income, be able to appropriate a larger amount to that fund, while bearing in mind that from causes peculiar to the district of supply, the returns had never equalled those of companies more favourably situated, and that in consequence the dividends had always been of an extremely moderate character, and they were continuously hoping that the increase in profits would enable the directors to put aside as much as most other companies did for depreciation, without any serious reduction in the amount of dividends paid. That expectation had not been realised, inasmuch as the progress, though steady, had not been as rapid as they looked for, but the company was better able to-day to bear the extra charges than at any previous period in its history. They believed that with the steadily growing income those appropriations would, in the near future, be readily met, and the financial position of the company be materially strengthened. They had been made after exhaustive examination by their engineering staff, and were based on the estimated life of the various kinds of plant, having in view that, although the plant was always kept up out of revenue to the highest working efficiency, yet there remained the eventuality of some of it becoming obsolete. Even now the amount set aside was not quite equal to that appropriated by the most prosperous companies, always bearing in view the special character of the tenure that electric light companies possess under the Acts of Parliament relating to them. He would like to illustrate what he had just said as to the progress of the company by the following figures:—The 1½ per cent. drop in the dividend was equivalent to £3,137, while the extra amount placed to depreciation was £3,500, and this had been done notwithstanding some adverse events. The adverse conditions were the increase in rates at the quinquennial re-valuation amounting to £1,189; the continued high price of coal, which averaged 5s. 6d. a ton dearer than in 1899, amounting to £1,438; and the loss by the gradual automatic reduction of price to consumers of £1,005. The first two of those items affected most companies, and they should recover from them in a very short time. He might point out that those three items together came to more than the extra amount placed to depreciation, and taken from dividends. The last item referred to—that of loss by reduction of price—was not at all to be regretted. They were now in fairly full use of the maximum demand system of charging their customers, and under that system a large number of the most useful class of customers got the current at a price which competed well with gas. The general public were slowly realising that fact, and the company was accordingly obtaining an increase of custom of a kind which would be the means of improving profits. Gross takings did not benefit the company unless they were of the right kind, that was coming from the class who used their lamps for long hours, and thus giving a better return on the capital expended in plant by enabling them to use it each day for a longer time. The lamp return was encouraging, the ratio of increase in the number of units sold per lamp being for the past three years as 11, 11½ and 12¼. The number of lamps added in 1901 (15,754) was about the same as that added in 1900, but the units sold showed an increase of about 340,000, which exceeded the usual increase by about 100,000 units. The district promised a continuous increase in the demand. Leases were falling in in the southern portion during the next two or three years, and in the northern part in six or seven years' time. Building plans were already in existence for the development of those areas, and the demand therefrom was expected to be of a remunerative order. Coming to the question of the reserve fund, he would point out that the Chelsea Company was a pioneer company, and had suffered in a variety of ways from that cause, as was the fate of most pioneer enterprises; legal questions arose and had to be fought out, involving as they did costly claims in connection with vibration, and the consequent abandonment of stations and sites, while all the early plant had to be scrapped to keep pace with the times, and to utilise new inventions of modern and more economical plant and machinery. Original sites had to be abandoned as the company grew in size, and land and buildings had to be acquired for the purposes of the business. The reserve fund had been created entirely out of premiums on the issue of shares and debentures, and was invested in the business. They proposed to write off capital expenditure out of the reserve fund, and place the balance to the credit of depreciation account. Other electric lighting companies had generally dealt with that matter gradually, while they were dealing with it in one operation, and consequently the largeness of its amount was more obvious. The capital expenditure for 1901 was small, being about £15,500 less than in 1900, and about £37,400 less than in 1899. They would not have to spend much this year for plant and buildings, but a certain amount would have to be spent on lands to be purchased under their Act for future use. The capital already subscribed would go far to meet their requirements in that respect. They expected that capital expenditure in the future would be smaller in proportion to the supply of current than hitherto, as they considered their present sub-station buildings would hold all the transforming plant they would require, and the mains on the 200-volt system were less costly than on the 100-volt system. Turning to the engineering work carried out, and the results attained during 1901, only a small amount of new construction and equipment work was carried out during the past year, as their Alpha Place works were now fully equipped, and in thorough working order. Their sub-stations also were in satisfactory working order, and only small additions to meet the increase in the demand for a supply of electricity were necessary. The efficiency of the whole of the plant had been well maintained, and its working had been all that could be desired. Their customers, as in previous years, had had no fault to find with the general character of the supply of electricity delivered to them, and the regularity and steadiness of the supply were readily admitted by customers who had had experience on electric circuits in other parts of London. Their network of mains now embraced the greater part of their area, and only comparatively small extensions had been carried out during the year to pick up customers in parts where a supply had not yet been delivered. Many of their earlier customers who were supplied at the old pressure of 100 volts had, during the year, changed over to the 200-volt supply, to take advantage of the more favourable terms which we are able to offer for the supply at the higher pressure. In some cases the result of that change had induced customers to have additional lamps wired in other parts of their premises which had previously not been lighted by electricity.

Major-General WEBBER seconded the motion.

Mr. BIRD said that a lamer report had never been put before a body of shareholders, and the Chairman in his speech had "capped" it. He had entirely evaded the all-important question of the reserve fund. After the years the company had been going on pretending to have a reserve fund of some £50,000 or £60,000, which had come out of the pockets of the shareholders, the board seemed suddenly to have discovered that the fund had entirely gone. As a consequence, the financial position of the company was very much weakened. Personally, he had not the slightest confidence in the old board, and in his opinion they had mismanaged the whole of the company's affairs. He therefore proposed the following amendment:—"That the report and statement of accounts be not passed, and that a committee of shareholders be appointed with full power to investigate the accounts and position of the company and the present administration of its affairs, and to report to the shareholders thereon; and that this meeting be adjourned till such report has been issued."

Mr. DAWES, in seconding the amendment, said the drastic changes which the board proposed to carry out had fallen upon the shareholders like "a bolt from the blue." It would certainly look as if the state of things disclosed in the report had only been discovered when the two new directors were appointed last year.

Mr. TUCKETT said he thought the two previous speakers had been a little too hard upon the directors. All electric undertakings lost

more or less of their assets through depreciation, and he thought the board had acted in the best interests of the company by taking the bull by the horns and writing the matter off at once.

Mr. SCRASE said that the company had been badly mismanaged in the past, and it was evident that the shareholders had been living in a fool's paradise. They had now two new directors in the persons of Mr. W. Page and Mr. W. Reginald Davies, who were business men, but if they were overweighted with the old directors, he was afraid they would not be able to do much for the company. He thought they should try to get rid of the old board.

Mr. GROVE questioned the legality of the board taking money from the reserve for the purpose of making provision for depreciation. If they had lost their ordinary and preference capital, the only thing for it was to reduce it.

Mr. DAVIES, as one of the new directors, said that he and his colleague, Mr. Page, had no wish to disassociate themselves from the other directors. The board might have made mistakes, but they had done nothing improper, and if they consented to leave the management of the business in their hands, he was convinced they would quietly and slowly, it might be, but steadily and surely give the shareholders an improved state of affairs from year to year.

The CHAIRMAN, replying on the discussion, said it was the intention of the board for the future to put to depreciation nothing more than would be put by any of the best and most prosperous companies. The reserve fund had always existed in the business, and nothing more than a transfer in accounts had taken place in the present balance-sheet. In dealing with the question as they had, he maintained that the board had adopted a perfectly honest and straightforward course.

On a show of hands, the amendment was rejected by 14 votes to 23, and the report was adopted.

After some opposition, the chairman and Major-General Webber were re-elected as directors, and the proceedings, which had lasted nearly two hours, terminated.

Liverpool District Lighting Company.

THE report for the year ending December 31st, 1901, states:—

The demand for electric light in the Great Crosby and Waterloo district has considerably increased, an equivalent of 2,670 16-C.P. lamps having been connected to the supply mains, making the total number of lamps installed at January 1st, 1902, 8,904. The revenue during the period has increased by about £600, while owing to economies in working the expenditure has been increased by £150 only. A better result would have been obtained but for an unfortunate breakdown of the batteries at the station which carry the night load, which necessitated running the steam plant night and day for a period of about six weeks in November and December. The contracting business carried on by the company shows a satisfactory progress. The profit on this portion of the business, however, is not very great, a large proportion of the work being carried out for consumers in their own district, where it is to the company's advantage to work at practically cost price for the sake of increasing the consumption of electric light. The Gateacre portion of the company's business has now been finally disposed of to the Garston and District Electric Supply Company, Limited, the surplus remaining after the payment of all expenses being £1,909 0s. 8d. From this sum the directors have thought it wise to write off the whole of the preliminary expenses of the formation of the company, amounting to £468 7s. 8d., leaving a balance of £1,440 13s. with which to form a reserve fund for the equalisation of dividends and for other purposes. The total profits for the year amount to £2,207 4s. 10d., out of which £624 10s. 2d. has been taken for depreciation, leaving the net profit available for distribution, including the balance brought forward from 1901, £2,129 19s. 7d. An interim dividend at the rate of 3 per cent. per annum, less income-tax, has been paid for the half-year ending June 30th, and it is proposed to declare a further dividend at the rate of 4 per cent. per annum, less income-tax, making 3½ per cent. for the year, and to carry forward £480.

Oldham, Ashton and Hyde Electric Tramway Company.

THE report, presented to the meeting held at Hamilton House, Victoria Embankment, E.C., at 12.30 o'clock on Tuesday, March 11th, read as follows:—

"The directors beg to submit their report and the statement of accounts as at December 31st, 1901. The total revenue for the year amounts to £26,401 16s. 11d., and the expenditure (including £1,600 for debenture interest) to £19,319 14s., leaving a net profit of £7,082 2s. 11d., which, added to the amount of £177 11s. 8d. brought forward from the previous account, makes an available balance of £7,259 14s. 7d., which the directors propose should be applied as follows:—

Amount to be placed to depreciation and reserve fund ..	£1,500	0	0
Dividend at the rate of 5 per cent. per annum on the cumulative preference shares for the year	2,122	18	4
Dividend on the ordinary shares at the rate of 11 per cent. per annum for the six months ended December 31st, 1901, making, with the interim dividend paid on August 15th last, 8 per cent. for the year	3,370	6	3
Balance to be carried forward to next account	266	10	0
	£7,259	14	7

"The total capital expenditure amounts to £132,751 17s. 6d. In order to cope with the traffic during certain days of the week and on holidays, the directors have purchased eight additional motor cars. In accordance with the resolution passed at the last general meeting, the directors issued in May, 1901, 500 ordinary shares and 500 preference shares at the price of £12 10s. per ordinary share and £10 per preference share. The premium in respect of the issue of these shares, amounting to £1,183 15s. 5d. (after deducting expenses), has been added to depreciation and reserve fund, which, with the sum now recommended to be credited, will stand at £4,505 15s. 5d. The subscribed share and debenture capital is now:—£45,000 in ordinary shares of £10 each; £45,000 in 5 per cent. cumulative preference shares of £10 each; £40,000 4 per cent. debentures—£130,000. A satisfactory agreement has been entered into with the Hyde Corporation in regard to the breaking up of the footpaths for the repair of the feeder cables. The directors regret that their opposition to the promotion of new lines by the local authorities was unsuccessful, but negotiations are in progress with the Hyde Corporation with regard to a lease to the company of the tramway from the terminus of the company's line to the Stockport boundary, and with the Stockport Corporation for mutual running powers between Hyde and Bredbury."

1900. Miles open:— M.	F.	Ch.		1901. M.	F.	Ch.
8	1	1	Route miles	8	1	1
5	6	7	Single line	5	6	7
2	2	4	Double line	2	2	4
4,131,589 ..			.. Number of passengers carried ..	.. 4,889,612		
1·34d. ..			.. Average receipts per passenger ..	.. 1·27d.		
·88d. ..			Average expenditure per passenger ..	·87d.		
65·86 % ..			Proportion of expenses to receipts ..	66·53 %		
38 ..			.. Number of cars in stock	46		

Mr. EMILE GARCKE presided over the fifth ordinary general meeting of the shareholders, and, in moving the adoption of the report, said he had to congratulate the shareholders upon the successful results which had been achieved since the line was opened to traffic, which was rather more than two years. That success exemplified in very typical form what could be done by means of the electrical working of tramways in districts similar to that which the company was serving. Interest on the debentures had been paid from the first, and the ordinary shareholders received 6 per cent. for 1900, and the board now recommended a distribution which would make the dividend on the ordinary shares for the past year 8 per cent. The permanent way, stock and plant had been maintained in thorough order out of revenue. The results had been in almost every respect as satisfactory as they could wish for, but they had suffered in the district from depression in trade owing to some of the mills and collieries having been on short time. Otherwise the traffic would have been slightly larger. They had carried 4,889,000 passengers in 1891 as against 4,131,000 in 1900. The receipts per passenger showed a slight falling off, but the average expenditure per passenger was also a little smaller than in the previous year. Parliamentary expenses amounted to £948, but the whole of it had not been spent in the period under review. They had arranged terms with the Hyde Corporation to lease the Corporation's tramways from the company's existing tramways to the boundary of the Hyde Borough. Further, they were arranging with the Stockport Corporation for running powers over the boundaries of their lines. He trusted that the result of those arrangements, by which mutual running powers were secured over the respective lines, would tend materially to improve the travelling facilities over the whole of the district. He regretted that the attitude of the local authorities had been so hostile to the company. Until their company's line was promoted, there were no tramway travelling facilities provided in the district, but directly the company appeared on the scene, they were opposed by the local authorities. The local authorities had got orders, and it was proposed to work the extended lines by means of a joint board. That company did not reciprocate the feeling of jealousy which the local authorities had never refrained from showing. They hoped the local authorities would do the work as thoroughly and as efficiently as the company was doing its work, and he trusted that the public would benefit by this division of tramways in the district. At the same time he could not refrain from expressing considerable doubt whether a system by which electrical tramways were split up between the company and various local authorities was the most satisfactory one for the interests of the travelling public.

Mr. ATHERLEY JONES, M.P., seconded the motion, which was carried.

Mr. E. Garcke and Mr. Alderman Higginbottom were re-elected directors, and the meeting closed.

County of London and Brush Provincial Electric Lighting Company, Limited.—The directors have decided to recommend payments of final dividends upon the ordinary shares of the company at the rate of 4 per cent. per annum, less income-tax, for the half-year ended December 31st, 1901, making 4 per cent. for the year, carrying forward about £4,000, and on the preference shares at the rate of 6 per cent. per annum for the half-year to December 31st, 1901, less income-tax.

Baker Street and Waterloo Railway.—It is officially announced that the contract for the sale of the interests of the London and Globe Finance Corporation in the Baker Street and Waterloo Railway to the Metropolitan District Electric Traction Company has been signed, the price agreed upon being £360,000 and interest. The directors announce that they have now completed arrangements with the Metropolitan District Electric Traction Company, Limited, to carry on the construction of the works.

Commercial Cable Company.—The accounts for the year ended December last, show that, after payment of dividends amounting to 8 per cent., and adding $350,000 to the reserve fund and $150,000 to the reserve for insurance of stations, &c., there remained a credit to revenue account of $130,604, $221,066 having been brought forward.

Direct Spanish Telegraph Company.—Dividends for the half-year ended December 31st, at the rate of 10 per cent. on the preference shares and 4 per cent. on the ordinary.

Bournemouth and Poole Electricity Supply Company.—Dividend on the ordinary shares at the rate of 7 per cent. for the year 1901.

Mexican Electric Works, Limited.—Dividend for the year ended September 30th, 8 per cent. per annum.

Telegraph Manufacturing Company.—The transfer books will be closed from 17th to 31st inst.

Commercial Cable Company.—A quarterly dividend of 1¾ per cent. has been declared.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending March 7th were £699; corresponding week last year, £546; increase, £153. Total to date, £5,737; corresponding period last year, £5,036; increase £701. Miles of track open, 10¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending March 8th were £199; corresponding week last year, £166; increase, £33. Total receipts to date, £1,521; corresponding period last year, £1,394; increase, £127.

Bristol Tramways and Carriage Company.—The receipts for the week ending March 7th were £4,882; corresponding period last year £3,753; increase, £1,129.

Central London Railway.—The receipts for the week ending March 8th were £6,757; corresponding week last year, £5,555; increase, £902. Total receipts to date, £66,113; corresponding period last year, £60,662; increase, £5,451. Miles open, 6.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending February 28th:—

Company.	Amount £	Comparison with corresponding week of last year. + £	Comparison with corresponding week of last year. − £	No. of weeks.	Aggregate. Amount. £	Aggregate. Inc. or Dec. + £	Aggregate. Inc. or Dec. − £
Croydon *	718	515	—	8½	5,382	3,678	—
Devonport ‡	307	—	—	8½	3,072	—	—
Dudley—Stourbridge	611	85	—	8½	4,962	863	—
Gateshead †	606	—	—	8½	5,120	—	—
Greenock-Pt. Glasgow	333	183	—	8½	2,901	1,489	—
Hartlepool	171	—	7	8½	1,369	—	30
Kidderminster ..	87	5	—	8½	723	61	—
Merthyr †	183	—	—	8½	1,513	—	—
Oldham—Ashton ..	465	14	—	8½	3,678	—	102
Poole ‡	166	—	—	8½	1,418	—	—
Potteries	1,374	58	—	8½	11,023	257	—
Southport	126	21	—	8½	986	144	—
South Staffordshire†	714	24	—	8½	5,715	203	—
Swansea	401	48	—	8½	3.223	216	—
Taunton ‡	54	—	—	8½	417	—	—
Tynemouth ‡	161	—	—	8½	1,455	—	—
Wolverhampton Dist.	125	76	—	8½	962	597	—

* Partly horse. † Partly steam. ‡ Not in operation last year.

City and South London Railway.—The receipts for the week ending Mar. 9th were £3,071; corresponding week last year, £2,067; increase, £1,004. Total receipts to date (10 weeks), £30,472; corresponding period last year, £20,198; increase, £19,274. Miles open, 6½; last year, 4¾.

Dover Corporation Tramways.—The receipts for the week ending March 8th were £166 9s. 6½d.; corresponding week last year, £159 18s. 3d.; increase, £6 16s. 6½d. Total to date, £1,609 10s. 10d.; corresponding period last year, £1,533 6s. 7d.; increase, £76 4s. 3d. Miles of track open, 8. Car miles run, 1902, 5,090; 1901, 4,934. Number of cars, 1902, 12; 1901, 11.

Dublin United Tramways Company.—The receipts for the week ending March 7th were as follows:—D.U.T. Co., £3,373 3s. 4d.; D.S.D. Co. £741 1s. 7d.; total, £4,114 4s. 11d.; corresponding week last year—D.U.T. Co., £3,154 2s. 4d.; D.S.D. Co., £647 6s. 11d.; total, £3,801 9s. 3d.; increase, £312 15s. 8d.; aggregate to date, £37,444 0s. 8d.; last year, £35,728 12s. 3d.; increase, £1,705 8s. 5d. Mileage worked 46.

Liverpool Overhead Railway.—The receipts for the week ending March 9th were £1,401; corresponding week last year, £1,507; decrease, £106. Total to date £13,609; corresponding period last year, £14,695; decrease, £1,086. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

Business in the Stock Exchange has dropped to proportions more generally associated with the dog-days than those of early spring, when orders should be bright and beautifully abundant. The unhappy "accident" at the front is, of course, a prime factor in causing the slackening of trade, although Lord Methuen's reverse is regarded as an event which can only affect the final issue in so far as it may encourage the enemy to prolong hostilities for a few months longer than they otherwise would do. Consols have receded, taking investment markets generally in their train, but the Telegraph section is halting in its previously head-long descent. Supply shares continue erratic, and the Electrical Railway department is somewhat easier.

The sale to Mr. Yerkes of that white elephant, the Baker Street and Waterloo Railway, will release about £360,000, the sum which is to be paid for the line, but whether creditors of the London and Globe Corporation will much benefit is doubtful, since it is believed that the property was heavily mortgaged. Some £650,000 has been spent by the Whitaker-Wright group over this hapless undertaking, and if the London and Globe shareholders get as much as £100,000 back again, they will probably deem themselves lucky. Central London Ordinary and Deferred stocks are following the path we ventured to mark out for them, and will probably go still lower. The Earl of Camperdown's negatived motion, calling for legislation whereby "tube" companies which caused damage should become liable at common law, is of course, regarded askance in the market, not so much for what it demands on the surface as for the limitless possibilities which it opens with regard to liability for damage. Notwithstanding its speedy withdrawal, there is an unpleasant taste left behind. The talk of an arrangement being arrived at between the Central London and the Metropolitan District, which will save the former company the construction of a new line to the City, has affected the stocks of neither. District Ordinary keeps steady at 31. Metropolitan Consolidated stock is 74½. Great Northern & City Preferred "A" shares remain at 8½ to 9.

The Telegraph market has pulled itself together a little, and the "rot" is, for the moment, stayed. The only noticeably weak spot is Commercial Cable, which is marked down 7½ points upon sales, largely on account of New York. The market is so limited, that the disposal of only a small amount of stock produces an exaggerated effect upon the quotation. Anglo-American Preferred is actually 1 per cent. better, and buyers have had to pay the top price of 90, but the Deferred has relapsed to 7½ again. In the Eastern group, "Chinas" have advanced 10s., despite the deadlock which is supposed to have taken place between the company and some of the Australian Commonwealth authorities. Eastern 4 per cent. Debenture stock has receded 3, and Eastern Extension Debenture is also a shade off. Western Telegraph shares exhibit renewed flatness, and Indo-Europeans, after keeping very hard throughout the Marconi "crisis," are £1 down this week. On the other hand, Globe Telegraphs maintain their position, although Submarine Cables Trust certificates are quoted at a much wider margin, the price being extended downwards.

National Telephone descriptions are hardening, the first and second Preferences both showing rises of a sovereign upon the better feeling induced by tardy recognition of the chairman's speech at the recent meeting. By the way, we suppose that many of our readers have been receiving circulars this week from the British Investors' Underwriting Corporation advising the purchase of shares in the American Wireless Telephone and Telegraph Company. These share touts have the impudence to offer them at 2⅝ per $10 share, the fraction, of course, representing the premium. The age of the American patent, and the exceeding doubtfulness as to its validity on this side, are, of themselves, sufficient to warn anybody against taking these shares, despite the boast that the company's position is impregnable. Marconi's shares have not suffered from the advent of this American product, but the closing price to-night (Wednesday) is dull at 3¼ upon renewed Irish sales. Not even the Canadian Government subsidy of $80,000 to the clever inventor has been enough to assist the price of his shares.

In the electricity supply section, Chelseas are better, and the Debenture stock is up a point, the movements being due to the appreciation of the healthier financial position of the undertaking, now that its encumbrances have been reduced. Metropolitan Ordinary, which spurted ½ on the dividend declaration, are back to below their previous price. The adverse decision in the House of Lords is mainly responsible for this. Westminsters have lost a ½ this week. Bournemouth and Poole, to quote a few provincial varieties, are 12½, 10 and 104½ for Ordinary, Preference and Debenture issues respectively. Folkestone shares are 6½, Hove 7½, and Oxford 5½. To go further afield, Calcutta Electrics are 7 to 8, Electric Lighting and Traction of Australia Preference are 4½, River Plate Electric Debenture stock 67½. These are, of course, the middle prices. London Electrics are ¼ up on the declaration of the Preference dividend.

British Electric Tractions continue dullish. The most interesting item connected with electric traction is that which announced negotiations between the London General Omnibus Company and Mr. G. V. Sims, the object being to supply London with a new electric omnibus.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations March 5th.	Closing Quotation March 12th.	Business done during week ended March 12th, 1902. Highest.	Lowest.
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	73/6	3½%	61s.	46 — 49	46 — 49	48	46¼
3,097,640	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	87 — 89	88 — 90	90	87½
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s. %	2s.	7½— 8 xd	7½— 7¾	7⅞	7⅞
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	...	3½— 4	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	...	...	165 —170	155 —165	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	95 — 98	95 — 98	96	95
16,000	Cuba Telegraph	10	7 %	...	...	4½— 5½	4½— 5½	...	...
6,000	Do. 10 % Pref.	10	...	...	...	13 — 14	13 — 14	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½— 9½	8½— 9½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	98 —102	98 —102	...	...
60,710£	Direct United States Cable	20	3½%	3½%	...	9½— 10½	9½— 10½	10½	9½
101,300£	Direct West India Cable, 4½ % Reg. Deb, within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	120 —130	120 —130	129¾	125
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	84 — 87	84 — 87	86½	85½
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	108 —112	105 —109	107½	105
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	11½— 12½	12 — 13	13	11⅞
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	109 —114	108 —113	109¾	109
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5¼%	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103	100 —103 %	...	...
180,227	Globe Telegraph and Trust	10	5¼%	5¼%	...	8½— 9½	8½— 9½	9	8½
180,042	Do. do. 6 % Pref.	10	...	...	...	13 — 14	13 — 14	13⅝	13 1/16
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	27 — 29	27 — 29	27⅛	27 1/16
75,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —103	99 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	38 — 42	37 — 41	37½	37¼
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	100 —104 xd	100 —104	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	..	¾— 1	¾— 1	...	...
590,000	National Telephone, 1 to 590,000	5	5 %	5 %	5 %	... — ...	... — ...	...	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	13 — 15	13½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	13 — 15	13⅜	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛	...	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	93 — 96	93 — 96	94	...
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	01 —105	101 —105	101½	101
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	...	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's...	8	5 %	5 %	...	6½ — 7½	6½ — 7½	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	119 —125	119 —125	...	...
58,000	United River Plate Telephone	5	7 %	...	...	4¾— 5¼	4¾— 5¼	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— 5	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	102 —105	102 —105	...	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	99 —101 xd	99 —101	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛ — ⅜	⅛ — ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	12 — 13	11½— 12½	12¼	11¾
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	102 —105	102 —105	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	100 —103	100 —103	...	...
88,321	West India and Panama Telegraph	10	8%	...	...	½— ¾	½— ¾	11/16	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 5½	5 — 5½	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3½ — 4½	3½ — 4½	...	...
80,000£	Do do do 5 % Debs., Nos. 1 to 1,800	100	...	...	...	100 103	100 —103	...	

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	⅜— ⅝	⅜— ⅝	...	...
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	...	...	...	100 — 105	100 —105	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	9 — 9½	9 — 9½	...	...
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	9 — 9⅝	9 — 9⅝	...	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	8½— 9⅛xd	8½— 9⅛	9⅜	...
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅝xd	5¼— 5⅝	5 15/16	5 7/16
250,000	Do. do. do. do. 4% Deb. Stock Red.	100	...	...	..	104 —106	104 —106	104⅛	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	4 %	4⅞— 5¼	5 — 5½	5⅛	5 1/16
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	110 —113	111	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	4 %	0 %	5 %	9 — 10	9 — 10	9¾	9⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	123 —128	123 —128	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	101 —104	101 —104	103	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	..	107 —110	107 —110	109	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	...	6 — 6½	6 — 6½	6 5/16	6 5/16
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	6 — 6½	6 — 6½	6 5/16	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	..	106 —109	106 —109	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10½— 11½	10½— 11½	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 2	1⅝— 2¼	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4 — 5	4 — 4½	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	..	95 — 100	95 —100	...	...
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	6½%	15½— 16½	14½— 15½	15⅝	15½
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	111 —115	111 —115	113⅜	112¾
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	98 —101	98 —101	...	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	6 %	14½— 15½	14½— 15½	14 13/16	
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	15	14⅞
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9 xd	8 — 9	.	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	98 —101	99½	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	1¾— 2¼	1¾— 2¼	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90 xd	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	..	2 — 2½	2 — 2½	...	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½%	10½%	11½ — 12½xd	11 — 12	11½	...

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
¡Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Mar. 5th.	Closing Quotation Mar. 12th.	Business done week ended Mar. 12th, 1902. Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	£ 10	...	...	...	4½ — 5½	4½ — 5½	...	...
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	88 — 92	88 — 92	...	...
62,074	British Electric Traction	10	8 %	9 %	...	13 — 14	13 — 14	13⅞	13½
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12¼ — 12⅜	12¼ — 12⅜	12⅝	12 5/8
600,000£	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	128½	...
70,000	British Insulated Wire Ord.	5	20 %	15 %	...	9½ — 10½	9½ — 10½	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅞ — 6¼	5⅞ — 6¼	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	18s. to 19s.	18s. to 20s.	...	...
50,000	¶ " " " 6 % Cum. Pref.	£1	...	6 %	...	20s. to 21s.	19/6 to 20/6	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	5½ %	5 %	...	1⅜ — 1⅝	1⅜ — 1⅝	1½	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	...	2 — 2¼	2 — 2¼	2	...
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	101 —104 xd	102 —105	103½	...
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	97 —100	97 —100	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	...	17½ — 18½	17½ — 18½	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	...	...
90,000£	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	111 —115	111 —115	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	103 —106	103 —106	104	103
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	103 —106	103 —106	105½	...
440,100	Do. do. Def. do.	Stock	...	...	4 %	100 —103	99 —102	99½	...
855,000	City and South London Railway	Stock	1¼%	1½%	2 %	65 — 68	65 — 68	67¼	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½%	8 %	...	3 — 3½	3 — 3½	...	...
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —104	99 —104	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½%	...	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½%	...	2 — 3	2 — 3	...	...
344,023£	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	78 — 83	78 — 83	...	...
100,000£	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	83 — 88	83 — 88	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅝ — 1⅞	1⅝ — 1⅞	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½ — 3	2½ — 3	...	...
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	97 —101	97 —101	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9¾ — 10¼	9¾ — 10¼	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 — 102	100 —103	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	17½ — 18¼ xd	17½ — 18½	17⅝	17½
35,000	Do. do. do. 4½ % Pref.	5	4½%	4½%	...	5½ — 6 xd	5½ — 6	5¾	...
50,000£	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	111 —115 xd	111 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21½	...
300,000£	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¾%	3¾%	1¼%	5 — 5¼	5 — 5¼	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	11 — 11½	11 — 11½	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	15½—16½	15½ — 16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	6 %	...	19/- to 20/-	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	38 — 41	37 — 40	38¼	37⅝
150,000£	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... %	...	...	102 —105	102 —105	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	10½ — 11½	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	92 — 95	92 — 95	93	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, $\frac{1}{16}$—$\frac{3}{16}$.
National Electric Free Wiring, $\frac{11}{16}$—$\frac{13}{16}$.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15.
Do. do. Pref. (£10 pd.), 10⅜—10⅝.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, March 12th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a " Nitric	per cwt.	22/-	22/-	..
a " Oxalic	per cwt.	82/-	82/-	..
a " Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	89/-	89/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a " " ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a " (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£20	£20	..
a Lead, Nitrate	per ton	£24	£24	..
a " White Sugar	per ton	£31	£31	..
a " Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit ..	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8d.	8d.	..
a " Caustic (76/80%) ..	per ton	£24	£24	..
a " Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	127/-	127/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a " Recovered	per ton	£5 10	£5 10	..
a " Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a " Crystals	per ton	£8	£8	..
a Bichromate, casks ..	per lb	2½d.	2½d.	..
METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b " Wire, in ton lots	per ton	£224	£224	..
b " Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £125	£75 to £125	..
c Brass (rolled metal 8" to 12") basis	per lb.	6¾d.	6¾d.	..
c Tube (brazed)	per lb.	8¼d.	8¼d.	..
c " " (solid drawn) ..	per lb.	7d.	7d.	..
c " Wire, basis	per lb.	7d.	7d.	..
c Copper Tubes (brazed) ..	per lb.	8¾d.	8¾d.	..
c " " (solid drawn) ..	per lb.	9d.	9d.	..
g Copper Bars (best selected) ..	per ton	£71	£71	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£71	£71	..
g " Rod	per ton	£71	£71	..
e " Electrolytic) Bars ..	per ton	£63	£63	..
e " " Sheets ..	per ton	£75	£75	..
e " " Rod ..	per ton	£68	£68	..
e " " H.C. Wire	per lb.	8¼d.	8¼d.	..
f Ebonite Rod	per lb.	9/-	9/-	..
f " Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine ..	per lb.	3/1½ to 3/3	3/1½ to 3/3	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i " Pig (Cleveland warrants) ..	per ton	46/8	46/9	1d. dec.
i " Forgings, according to size	per ton	From £11	From £11	..
i " Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i " Wire, galvanised No. 8 ..	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£11 15	£11 17 6	2s. 6d. dec.
g " " Sheet	per ton	..	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d " " " medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p " rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/8	..
p " " strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	10d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i " " in bars		£58	£58	..
g Tin, block	per ton	£117 to £118	£116 10 to £117 10	10s. inc.
g " foil	per lb.	1/6	1/6	..
n " wire, Nos. 1 to 16	per lb.	1 6½	1/6½	..
p White Anti-friction Metals —				
"White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'le	per lb.	7d.	7d.	..
j " 6 lea. Flax	per lb.	5½d.	5½d.	..
j " 3 ply 10 lbs. Russian ..	per lb.	4½d.	4½d.	..
j " 10 lbs. Russian, single ..	per lb.	4½d.	4½d.	..
j " 180 lbs. Jute rove	per ton	£10 2 6	£10 2 6	..
k Zinc, Sheet (Vielle Montagne bnd.)	per ton	£22 10	£22 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. (Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. F. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd p The Phosphor Bronze Company, Ltd.

THE GERMAN ELECTRICAL ENGINEERING INDUSTRY.

THE DECLINE IN PROMOTIONS, AND EXPECTATIONS CONCERNING THE NEW TARIFF.

THE general industrial depression which has prevailed throughout Germany during the past year has not been without effect upon the electrical engineering industry, and although to some extent a satisfactory number of orders has been received for installation work, there has been a heavy decline in large and important contracts, due to the manifestation of little enterprise, the tightness of the money market, and the failures and financial losses which have occurred in various directions. During the year 10 electrical companies were formed, with a total capital of only £322,500, as compared with 15 companies and £1,383,500 capital in 1900. The promotions in the previous years will be understood from the fact that the capital of new companies constituted amounted to £1,729,500 in 1899, £2,327,500 in 1898, £4,815,500 in 1897, and £552,500 in 1896, but not a single undertaking was floated in 1895. In discussing the situation in their annual report, the directors of that influential institution, the Deutsche Bank, state that the existing reaction will probably be overcome as soon as the improvement which is hoped for in the general position has taken place. But it may safely be asserted that little progress will be made in this direction until the German Parliament has settled the question of the new tariff, and concluded fresh commercial treaties. The large increases proposed on the imports of many manufactures have already led to suggestions for the adoption of retaliatory measures in different countries. Switzerland has just elaborated a new tariff, which projects an advance on all classes of machinery, and Austria and Russia are taking similar action. It is already difficult, under the existing Russian tariff, for German firms to carry on a profitable export trade with that country, and it is noteworthy that the Russian Siemens & Halske Company, of St. Petersburg, attributes the decline in its profits during the past year firstly, to the unfavourable Customs dues, and secondly, to the unsatisfactory condition of trade in general. If, therefore, Germany adopts the present tariff proposals, and alienates the sympathy of other countries to the extent of compelling them to resort to reprisals, there is hope that British firms may avail themselves of the opportunity which should then be afforded of extending their business connections in Europe.

The shareholders of the Siemens & Halske Company, of Berlin, who recently approved the payment of a dividend at the rate of 8 per cent. for the past financial year, were informed by President Bodiker that, although the conditions of the industrial market are not clear and distinct, there is some consolation in regard to future developments, especially as expression to this assumption is being given by customers. At the same time, he was careful to point out that by reason of its extensive connections, the company is not dependent upon the general course of trade for its prosperity. The president proceeded to remark that indications are not lacking of an improvement in business, in view of the termination of the disturbances in China, and the approaching conclusion of the war in South Africa; but the negotiation of favourable commercial treaties would principally contribute towards the dissipation of the existing uncertainty. As far as the operations of the company during the past financial year are concerned, the dividend of 8 per cent. shows a decline for the first time in the past five years, the distribution in each of the four preceding periods having amounted to 10 per cent. It is only fair, however, to state that the whole of the share capital of £2,750,000 participates in the dividend on the present occasion. The gross profits amounted to £454,304 as compared with £485,025 in the previous year, and the net profits to £324,149 as against £353,095. The company's report states that the stagnation in trade and industry has brought about a diminution in the working results, although the volume of work turned out has been greater. The many branches of activity of the undertaking afford a certain compensation to the change in the industrial situation, and the company has found it useful to have considered the promotion of enterprises as a matter of secondary importance. An increase in competition has been experienced in the company's departments, with the result that prices have declined, and American rivalry has become noticeable in regard to the specially low prices at which railway motors have been offered. The report refers to the completion of the Berlin elevated and underground railway, the experiments being made in Berlin and Vienna in the direction of the electrical operation of main lines of railway, and the high speed tests on the military railway between Marienfeld and Zossen, and it also mentions that important contracts have been entered into for the construction of conduit electric tramways in the capital. A company has been formed in conjunction with Prof. Braun for the exploitation of the latter's system of wireless telegraphy, whilst a Hanseatic Siemens & Halske Company has been constituted at Hamburg for the purpose of electrical contracts in connection with the Navy and the merchant marine. The cable works have found full employment during the year, and an india-rubber factory has now been established in the Westend, near Berlin. The balance-sheet shows that the permanent investments of the company have increased from £449,000 to £567,000, these being mainly composed of shares in Messrs. Siemens Bros., of London, and the Russian Siemens & Halske Company.

The directors of the Lahmeyer Company, of Frankfort-on-Maine, are taking a step which will doubtless have an important effect upon the future operations of the company, which, it may be remembered, has, as its trust, the German Company for Electrical Enterprises. It was thought advisable, a few months ago, to consider the question of exchanging shares in the parent concern for those of its offspring in the proportion of two of the former for three of the latter, and a scheme on this basis was carried through in January by increasing the share capital of the Lahmeyer Company from £500,000 to £1,000,000, the new shares being issued to the holders of the ordinary capital in the German Company. This transaction has, however, left out of consideration the 4½ per cent. loan of the German Company, amounting to £500,000, and redeemable in 1939 at 103 per cent. These bonds, in the event of the latter being liquidated before that year have to be redeemed immediately. It is now proposed to amalgamate the two companies, and in order to obviate the necessity for paying off the obligations at once the holders have been asked to accept in exchange bonds of a similar nature in the Lahmeyer Co. The latter has a loan debt of £300,000, of which £200,000 is in 4 per cent. bonds, and £100,000 in 4½ per cent. bonds redeemable at 103 per cent. As the holders of practically all the obligations in the German company have consented to the exchange, the success of the amalgamation is assured, and in this manner the first electrical trust in the Fatherland will pass into oblivion by absorption.

The operations of the Schuckert Company, of Nuremberg, especially in relation to the projected realisation of investments in other undertakings, continue to occupy considerable attention in Germany. It appears from an official statement that the loss on the sale of the company's interest in the Bosnian Electricity Company, of Jaice, amounts to £25,000, and that the company now only has a claim against it on current account of £63,350, but this has been guaranteed by the syndicate which has taken over the Jaice works. Having thus settled this matter, the company, in conjunction with its trust, the Continental Company for Electrical Enterprises, of Nuremberg, has turned its attention to the Société Lombarda per Distribuzione di Energia Elettrica, of Milan, whose generating station at Vizzola was recently described as the largest electricity works in Europe where water power is used, and which has a primary 11,000-volt network nearly 75 miles long. This enterprise is said to possess excellent prospects, but the Schuckert and the Continental companies have found it necessary to dispose of their holdings in it, and it is reported that the shares have been sold to an Italian syndicate at a slight premium for the sum of £240,000. Whilst referring to Italy, a remarkable case which has just been decided at Florence is worthy of mention. In this instance the local gas company has obtained an injunction against the Tuscan branch of the Schuckert Company restraining it from continuing to supply electrical energy in Florence, and compelling it to pay the damages incurred by the gas company, whilst the judgment of the Court also absolves the local authorities from any responsibility for the concession granted to the electric lighting company. It is possible that the case may be taken to the Court of Appeal on the latter point, but it is considered that the prospects of success are remote. At any rate, the Nuremberg company is reported to have already written down the value of its holding in the Florence concern in order to meet the circumstances of the case. It is stated further that the company is endeavouring to transfer the Stuttgart electricity works to the town authorities at an earlier date than is provided for under its agreement, and to realise its shares in the Austrian Schuckert Company, but the latter rumour has now been contradicted. With regard to the proposed community of interests with the Allgemeine Company, of Berlin, it does not appear that any progress has been made. The latter regards the manufacturing branch of the Schuckert Company with favour, but it does not welcome its promotion risks, and the complications with the Continental Company.

The proceedings in connection with the Kummer Electricity Works Company, of Dresden, the failure of which took place last June in connection with the Dresden Credit Anstalt, continue to occupy attention, and everything is being done to realise the assets. Dr. Mittasch, the liquidator of the company, states that preference claims have been lodged amounting to £22,330, of which £9,500 has been allowed, whilst other claims have been presented to the extent of £1,150,000, of which £541,000 is disputed. In addition to these there are the deficiencies arising from the issues of bonds of £200,000, and other mortgages reach £26,276. It is expected that the estate will realise about £150,000, of which £81,000 is already in hand, and creditors are being asked to abstain from legal actions and to enter into friendly negotiations. It will be obvious that there will not be much to divide among the mortgage and bondholders as a result of this heavy failure. It is a remarkable fact that an issue of 5 per cent. obligations of £125,000 took place about six months previous to the crash, and the holders of these are not unnaturally vexed at having been induced to invest money in a concern which at that time could not have been solvent.

The Watt Accumulator Company, of Berlin, which has a capital of £75,000, has a disastrous record, and even the chairman of the concern has been compelled to admit that too optimistic a view has been taken of the situation. During the past financial year a loss of over £30,000 has been incurred, and the total deficit has thereby been increased to £62,500. The anticipations which were entertained respecting the accumulator cars on the Berlin—Charlottenburg tramway have not been fulfilled, but the unremunerative contract with the tramway company for the maintenance of the batteries has now been terminated. Other losses have resulted from the Kummer failure at Dresden, and the effect has been to prevent any repeat orders being given by the Wurtemberg State Railway authorities for batteries for use in the experiments in connection with the working of main line passenger cars on these lines. On the other hand, the dry cells which are being used for passenger boats are proving satisfactory, and plenty of orders have been received for the new machine construction department. The com-

pany, which fully appreciates the fact that the maintenance of batteries for street cars involves large expenses, has now decided upon a scheme of reorganisation whereby the existing capital will be written down to £12,500, and a further call made upon the shareholders to provide £37,500. The proposal will, however, not be carried into effect unless the subscriptions amount to £30,000.

The German Company for Electrical Enterprises, which, as already mentioned, is now being amalgamated with the Lahmeyer Company, of Franfort-on-Maine, has tardily issued its report for the financial year 1900-1901. It shows a gross profit of £78,195 as compared with £61,118 in the preceding year, and a net profit of only £25,620 as against £57,556. The large diminution in the net profit is due to the payment for the first time of interest on the £435,000 4½ per cent. obligations issued in the previous year and the writing down of investments in consequence of the depreciation of these securities. The ultimate result is a proposal to pay a dividend at the rate of 3 per cent. on a capital of £750,000 as compared with 6½ per cent. on £690,000 in the previous year.

The Electric Light and Power Investment Company (Elektrische Licht und Kraft Anlagen A.G.), of Berlin, which has a paid-up capital of £937,500 out of a nominal capital of £1,500,000, has increased its profits during the past year by the disposal of some of its holdings at remunerative prices. As a result, the gross profits, arising from interest, securities, and syndicate business and commissions, amount to £90,540 as compared with £79,830 in the previous year. The interest on the 4½ per cent. loan of £500,000 having now become fully payable, the net result is a profit of £61,195, out of which a dividend of 5 per cent. is to be paid as against 5½ per cent. last year. Among the investments disposed of at a profit during the year the company refers to the sale of the shares which it held in Messrs. Siemens Bros & Co.

The Siemens Electrical Operation Company (Elektrische Betriebe), of Berlin, was formed two years ago, mainly for the purpose of taking over and continuing central stations and tramways established by the Siemens & Halske Company. It has a capital of £250,000, and has raised a 4½ per cent. loan of £250,000. During the past year the net profits have allowed of the payment of a dividend at the rate of 5 per cent., as in the previous year. Besides German works the company is interested in Italian central stations or tramways at Pisa, Perugia, and Alessandrina.

INSTITUTION OF ELECTRICAL ENGINEERS. (MANCHESTER SECTION).

THE CONSTRUCTION OF HIGH TENSION CENTRAL STATION SWITCHGEARS.

By Henry W. Clothier, A.M.I.C.E., A.M.I.E.E.

(*Paper read February 1st*, 1902.)

(*Continued from page* 375.)

Switch-Gear without Backs.

Wall Surface.—Fig. 10 illustrates the type of switch-gear constructed at Deptford in 1888, the first station in this country where power transmission on a commercial scale was attempted. Although in designing this station for 10,000 volts Mr. Ferranti was at least 10 years before the times, yet the switch-gear then installed has certain advantages not to be found in many of the modern designs.

It will be seen from the drawing that the general idea was to support the extra high-tension conductors on porcelain or ebonite insulators mounted directly on the surface of one of the walls of the station. Thus all connections were visible and easily traced by a person standing on the platform. To prevent arcing between adjacent conductors a liberal area of wall was occupied, and slate or marble partitions were set here and there in the wall at places where the clearances dividing parts of different potential were limited. Each panel can be isolated from the main inner bus bar by the removal of a plug with the aid of a long insulated hook. The main switches are of a long spring-break type, the machines being entirely controlled by levers mounted on the platform. Thus, although the operator has always a clear view of all his connections, yet they are so far out of his reach that he cannot make accidental contact with them in the ordinary course of his duties.

Pillar Type.—This type also deserves a place in the front rank of English designs, the best known being that designed by Mr. Raworth many years ago and constructed by the Brush Company. There was one complete unit of switches, instruments, &c., for each generating plant, enclosed in a pillar as shown in fig. 11. The illustration in question represents a view of a dynamo pillar with water-break switch at the top controlled by a handle protruding from the front at a lower level. The merits of the design, however, have not been confirmed in actual practice. In fact, as stations grew in size the system appears to have been found inconvenient and costly, with the result that the pillar type has become almost obsolete in England.

Hinged Panel.—This ingenious construction, invented by Mr. Cowan, consists of an arrangement by which the vertical panels supporting the high-tension switches, instruments and fuses, can be hinged from the bottom. The operation of unhinging disconnects the entire panel from the bus bars and affords ready access to the connections. This type, though very serviceable for small units, becomes difficult in construction when larger units are to be controlled, but fig. 12 shows the method applied to meet the require-

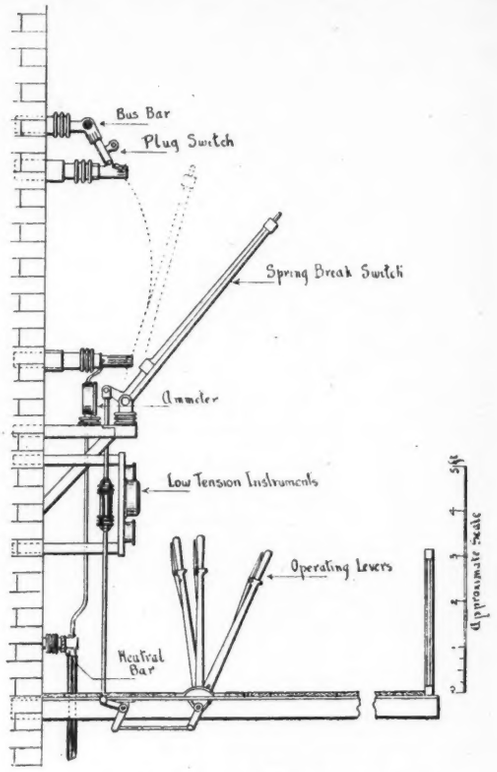

Fig. 10.—Wall Surface Type Switch Gear.

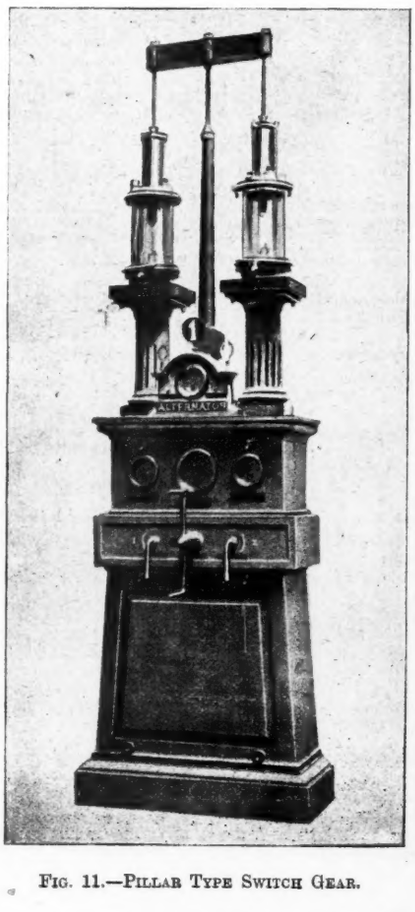

Fig. 11.—Pillar Type Switch Gear.

ments of larger units by mounting the switch solidly at the top. The hinged panel below contains the other fittings. It is evident from the illustration (fig. 12) that, although there is still an interval

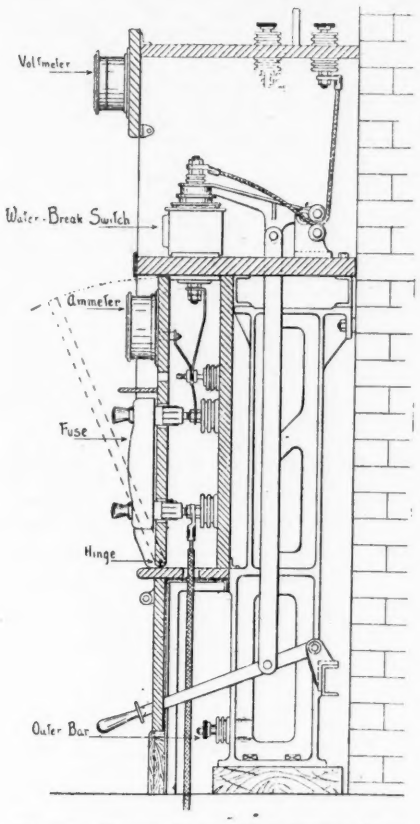

Fig. 12.—Hinged Panel Type Switch Gear.

between the flat panel and the wall, this space is so reduced that there is no chance, even if there were the necessity, for anyone to go behind.

(To be continued.)

CURRENT SPECIFICATIONS.

XCIII.—HECKMONDWIKE EXTENSION PLANT.

Summary.

Extent of Contract.—Supply of plant under seven sections:—(*a*) Steam, water and exhaust piping; (*b*) 150-kw. steam traction generator; (*c*) Storage battery and reversible booster; (*d*) Traction switchboard; (*e*) Condenser and oil extractor; (*f*) Water cooling tower; (*g*) Underground work and cables.

Arrangement of Pipes.—All to be in accordance with plan accompanying specification, steel main steam pipes, wrought-iron subsidiary steam pipes, cast-iron exhaust pipes, and cast-iron water pipes.

Feed Water Filter.—To be of Rankine or other approved type suitable for insertion in the path of a 2½ in. feed water main.

Type of Engine.—To be of the vertical compound enclosed high speed type suitable for working condensing or non-condensing at all loads without alteration of valves.

Working Pressure.—160 lbs. per sq. in.

Speed.—Not to exceed 460 revolutions per minute.

Emergency Load.—180 kw. for two hours.

Governor.—To be of the automatic expansion type, adjustable by hand whilst running. Governor to be capable of controlling the engine speed within 2 per cent. between no load and full load, and to keep the momentary variation when full load is removed within 5 per cent.

Type of Dynamo.—To be of multipolar type, direct coupled to engine, shunt wound with resistance suitable for varying voltage at constant speed between 460 and 530 volts.

Commutator.—To be arranged to give 1 in. radial depth of wearing surface, and arranged so as to permit of sparkless running between no load and 25 per cent. overload.

Permissible Temperature Rise.—Not to exceed 60° F. after six hours' run at full load. If it exceeds 70° F., the machine may, at the option of the engineer, be rejected.

Permissible Current Density.—1,000 amperes per sq. in. in field magnet circuit, 1,500 amperes per sq. in. in armature circuit.

Steam Consumption.—Not to exceed 32 lbs. per kw.-hour at full load when working non-condensing supplied with steam at 160 lbs. pressure. Guarantees at three-quarter and half load to be given in tender.

Storage Battery.—To consist of 240 cells, each cell to be capable of maintaining a discharge at the rate of 200 amperes for one hour without injury, the pressure at end of discharge not being less than 1·85 volts per cell.

Reversible Booster.—A reversible booster of the "Highfield" type to be provided, with a normal capacity of 100 amperes, consisting of three machines mounted on one bedplate. To be capable of dealing with 50 per cent. overload for half-an-hour, or 100 per cent. overload momentarily.

Switchboard.—Main traction switchboard suitable for use with cells and reversible booster, as per plan supplied with specification and detailed requirements.

Condenser.—To be of surface type, complete with air and circulating pump of latest and most approved type, the combination to be suitable for dealing with 8,000 lbs. of exhaust steam per hour.

Area of Condenser Cooling Surface.—Not to be less than 950 sq. ft.

Oil Extractor.—To be of latest and most approved type, capable of extracting the whole of the oil from the exhaust steam. To be of a type in successful use, and suitable for discharging the oil without breaking the vacuum.

Cooling Tower.—To be of forced-draught type, the fans being driven by means of an electric motor for dealing with the water and with the above surface condenser.

Underground Traction Feeders.—Lengths given in specification. To be of approved type, lead-covered, laid in separate troughs in an approved manner.

Specified Date of Completion.—Sixteen weeks from date of order.

Penalty for Late Completion.—£2 per cent. per week, and, in addition, any damages claimed against the Council by the British Electric Traction Company for damages for non-fulfilment by Council of their engagement to supply current.

Terms of Payment.—80 per cent. of plant delivered or work executed on site. 10 per cent. three months after completion or date at which plant is put into beneficial use, and 10 per cent. at end of period of maintenance.

Period of Maintenance.—Twelve months from date of completion.

Stipulations as regards Removal of Foreman.—Satisfactory.

Stipulations as to Wages to be Paid to Workmen.—None.

Arbitration Proposals.—Satisfactory.

Date for Receipt of Tenders.—March 15th, 1902.

This specification has been issued by the resident engineer to the existing undertaking, Mr. George H. Carter. The technical requirements are clearly stated, and no attempt is made to unduly limit the responsibility of the contractor. Boiler power will be provided under another contract, the present set of specifications only making provision for the plant required from the boiler stop valve onward. It will be noted that a battery of accumulators is to be worked in conjunction with a reversible booster, and that this arrangement permits of a shunt wound dynamo being employed for traction work. The current from this new instalment of plant will be used for driving the electric tramcar system running through the town, owned by the British Electric Traction Company.

It should be noted that the work in all sections is required within 16 weeks of date of order, and that not only a penalty of 2 per cent. per week is demanded for late delivery, but *in addition* the defaulting contractor is to be liable for any penalties which the Council may have to pay to the British Electric Traction Company under the agreement they have with them. We consider that in demanding not only penalty, but in addition damages, the Council are exceeding their powers, and in any case we strongly advise all contractors to enter a strong protest against this dual liability. We have on many occasions stated our decided opinion that the maximum penalty which can fairly be demanded for late delivery is 1 per cent. of contract sum per week, and this view is in harmony with the decision arrived at on the subject at the conference of representatives of the Municipal Electrical Association and the Electrical Plant Manufacturers' Association. It would, therefore, be advisable for tenderers to offer to submit to this penalty and decline to be responsible for any possible consequential damages which the tramways company may claim from the Council.

The arbitration clause is unlimited, and drafted in accordance with the requirements of the model clause, the terms of payment are satisfactory, and the remaining clauses are such that they may be accepted without fear.

We note that though the advertisement demands a deposit of £2 2s. before a copy of the specification is sent, this sum being as usual returnable on receipt of a *bonâ fide* tender, another copy of the specification may be obtained by the tenderer for his own use by a further payment of 10s. 6d. This plan might well be followed, for in many cases it is a real convenience to the tenderer to have the specifications in duplicate, and to be able to retain one for reference when the tender is sent in.

Ilkley.—A large number of ratepayers have presented a petition to the D.C. praying for the installation of the electric light. The Council desires to arrange for obtaining a supply of electricity in bulk from the Yorkshire Electric Power Company.

TUNBRIDGE WELLS TELEPHONES.

On the 6th inst. the adjourned Local Government Board inquiry into the application by the Corporation of Tunbridge Wells for a further loan for telephone purposes was continued. There were the same legal gentlemen present as on the last occasion as well as a fairly large number of burgesses and members of the Town Council.

Mr. Bennett's cross-examination was continued by Mr. Elvy Robb.

You show your full capacity of plant as revenue earning?—That is so, but there will be a proportion of spare lines.

How can you have spares, and yet estimate all the plant as revenue earning?—I said there would be spares.

Are these spares in addition to the lines estimated for revenue?—There will be a proportion.

How many?—I cannot say. We cannot foresee everything.

You know that this application is based on your report that 1,194 lines are provided for £25,000?—There will be spare wires.

Do I understand you will have a fair proportion of spare wires without additional capital expenditure?—There will be spare wires.

But what proportion?—It is impossible to foresee.

I must press you for an answer, as 25 per cent. is laid down as the proportion of spares in a properly equipped system?—It depends on the development of the system.

I am quoting statements that you have made at other places. What do you allow for unproductive lines?—Spare lines are not necessary.

The Inspector: Answer the question.

Mr. Robb: You recollect what you state in your Brighton report?—No particular number has been provided.

I ask you where you provide it, and how many are provided?—I cannot tell you how many. We have got spare wires.

When the money is spent how many spare lines will you have?—I cannot discriminate.

Are they, or are they not, included in the estimate?—Some of them are.

How many?—I cannot commit myself to a definite number.

But you are the engineer who laid out the scheme; surely you know the proportion of spares you provide as necessary?—You cannot foresee.

But this question goes to the root of the accuracy of your estimates?—I do not see it.

Will you tell me any telephone system which has less than 25 per cent. of spare wires?—I am told Cardiff. They cannot execute orders because they have not spare wires.

Then I suppose you cannot execute orders in Tunbridge Wells if you have displayed the same neglect?—There is a limit.

But you know what a well-equipped system should have, and I asked you again how many spare lines will you have?—I cannot say.

Do you recollect the evidence of Mr. Webb at the Glasgow Inquiry?—Oh! He is an American.

Do you suggest that is to his detriment?—(No reply).

He is a fellow Member of the Institute of Engineers, although you called him a Tammany man?—I must protest; I did not say so.

What did you mean then by the statement you made at the last inquiry about Mr. Webb and Tammany?—(No reply).

If all the lines are put down as earning revenue, how are the spare lines provided?—There will be spares.

Are they provided in the 1,148 lines you have estimated for, or are they not?—They are not.

I have got at that at last. The whole estimate turns on whether spare lines, which Mr. Bennett calls unproductive, are reckoned as revenue earning or not. Do you admit they are reckoned in revenue?—Some of them are.

How can you claim them as revenue earning and as spare lines at the same time?—We shall take out the spares afterwards.

What is your proportion of spare in the 1,148 lines you estimate?—It is impossible to say.

How many lines above the 1,148 do you provide for £25,000, so as to get your proportion of spares?—I will not pledge myself any number. I will pledge myself to some.

How many?—(No reply).

The Inspector: Cannot you give some approximate idea?

Mr. Robb: You are the consulting engineer who has worked all this out.

Witness: There may be 40 or 50.

That is a small proportion. How many have you estimated in the 1,148 lines?—I decline to commit myself.

I thought so. I suggest that you have provided no spares and are estimating revenue on the whole?—That is not so.

But I have asked you repeatedly to show the contrary. Now on the question of maintenance, you told the inspector that you never recommended a weekly inspection of instruments?—Not at Tunbridge Wells.

You say once in three months at Tunbridge Wells, but do you recollect giving quite different evidence at Glasgow?—That was different.

You recommended once a week, and not once in three months at Glasgow?—I was speaking of the N.T.C. system.

Of course you distinguish between a virtuous corporation and a wicked company, but how do you reconcile the two statements?—I have previously explained.

It depends whether you are giving evidence with regard to your own plant or somebody else's?—I do not say that.

I am going to quote the words of a great expert: "It is the constant tendency towards expansion displayed by all telephone systems which renders it necessary to provide in the estimates for so many partially completed lines. The capital invested in these is for a time buried and unproductive, while the interest and other charges upon it have to be borne by the earnings of the completed lines. But, on the other hand, it would be impolitic to lay lines sufficient only for immediate needs. If that were done, customers joining later on could only be provided for by opening the streets afresh at much additional cost and inconvenience, and by replacing small poles by larger ones.

"Although the spare lines constitute a burden at first, they also form a reserve of earning power, which has a marked influence for good on the net revenue as soon as they come to be occupied."

Mr. Cripps: What are you quoting from?

Mr. Robb: I am quoting from Mr. Bennett himself against himself.

Do you recollect your evidence at Glasgow about the defects of an overhead system like we have in Tunbridge Wells, and atmospheric disturbances?—There is not much effect from atmospheric disturbances.

How do you reconcile the two statements?—Atmospheric disturbances have not much effect.

That is not what you said in your Glasgow evidence?—I say so now.

How do you reconcile it?—It does not require to be reconciled.

And you have not made provision for damage?—No.

Notwithstanding your evidence at Glasgow?—There is not often a serious atmospheric disturbance.

As to telephone instruments, you say that £2,316 is sufficient to provide 1,194 instruments?—That is so.

That is less than £2 a-piece?——

Mr. Bennett consulted with Mr. Gardner, the late local manager, before answering the question, and explained that he based his previous reply on there being extra instruments in stock.

Then your estimate is not correct; you must add to it?—(No reply.)

If you have not allowed sufficient, you must amend your application to the Local Government Board?—I suppose so.

I suppose you will agree that £2 is not sufficient to allow for each instrument. You cannot get a good one under £2 10s.

Mr. Cripps (interposing): I can explain how the mistake has arisen. The accountant tells me that there will be money in hand to pay for the instruments required.

Mr. Robb: For which your estimate is insufficient. That brings me to my point that £2 apiece is not enough to allow.

Witness: £2 10s. is the proper price.

Then your estimate is inaccurate?—There must be an oversight in connection with it.

Mr. Cripps: We will make an application to the Local Government Board to increase the loan. It is a small matter.

Mr. Robb: On your own figures it makes a discrepancy of over £500 on this item alone.

The Inspector: Will you make the application to amend the loan now?

Mr. Cripps (after consulting the accountant): We may avoid that by taking the amount out of contingencies.

Mr. Robb: You cannot charge much to the contingency fund, which is not very large for all the demands upon it.

Then as to the item for batteries; you have a very small allowance?—We only use one cell.

I suggest that two cells are, in expert opinion, necessary for trunk lines?—I do not admit that.

If you cannot tell me, who can? Am I to ask the borough accountant?—(No reply.)

Now as to the switchboard. You only allow £927 for 1,194 lines?—When you have so much to fall back on you do not estimate closely.

Do you say that £927 is sufficient for a switchboard for 1,194?—Yes, in addition to the expenditure already incurred.

The Inspector: The estimate there appears to be exceeded by £237.

You estimate less than £1 per head. A proper switchboard cannot be provided on such an estimate?—For a small switchboard it is enough.

But how are you going to connect up 1,148 lines within your estimate?—We have not reached that number yet.

But your estimate contemplates that number. And the more you have the more the cost goes up?—After it attains considerable dimensions.

The Inspector: Do you adhere to your original estimate?

Mr. Bennett: It may be a point to be considered.

Mr. Robb: I am much obliged to the Inspector for getting an answer for me; I find it difficult. Now you said last time that when you get 600 subscribers the switchboard must be replaced by a multiple one?—Yes.

Have you made provision for that?—No, we do not expect to exceed that number.

But in estimating revenue you do exceed that number. Is it a fair estimate to credit yourself with the largest amount of income, and estimate your expenditure on a smaller number of revenue earning lines?—I am not doing that.

Then how do you manage your 1,148 lines without a multiple switchboard?—It is not necessary at the present time.

The multiple switchboard is the most efficient?—There is an American one which might be preferred.

Then you make no provision for the switchboard necessary when you exceed 600?—Under this estimate I do not contemplate it.

The National Company have 600 subscribers here, and as they have a multiple switchboard you are at a disadvantage in efficiency?—I do not know that they have a multiple switchboard; I am not sure.

Mr. Robb: What I want to know is if the system which has the multiple switchboard has not the best service for efficiency and secrecy?—You are holding up as a working model——

The Inspector: Answer the question.

If the National have the multiple switchboard and you have not, they have the most efficient service?—I can make it as efficient.

You have not provided for that expenditure in your estimates, and experts say you ought to have a multiple switchboard here at the present time?—I do not admit it.

Is it a fact that under your system a good deal of talking is necessary between operators which does not occur in the automatic system of the National Company?—One operator would have to speak to another.

You have not got an automatic system like the National?—Our system is sufficient for the present.

But it suffers from drawbacks which would be removed if you had a multiple board?—In America they are using a transfer system.

But you contemplate having a multiple board?—I qualify that by saying if it is necessary.

According to your evidence which I quoted, it is necessary now?—We might have the transfer system.

You recollect the report you presented to Brighton?—I do not think we ought to go into that.

Did you recommend a £5 5s. rate there?—I think it was £5 10s.

Did the Brighton Corporation reject that?—No.

Is it not a fact that they were not satisfied with your estimates, and they fixed a £7 rate as necessary to meet expenses?—I never heard of it.

Do you mean to say you do not know what has been done at Brighton on your report, or the correspondence on the insufficiency of your estimates?—I am not aware of a £7 rate.

What is the rate to be then?—There was a question about the matter.

Do you recollect your Eastbourne report better? You stated last time that copper was cheaper when you gave that report?—I do not think so.

You accounted for the difference in the figures by saying that copper was cheaper, but comparing the dates of the reports the reverse was the case?—I will not be positive on the point.

If you cannot explain the difference in your estimates on the price of copper, what do you attribute it to?—(No reply.)

Mr. Cripps: That has all been gone into, and it does not affect this inquiry.

Mr. Robb: I have quite enough difficulty in getting answers from Mr. Bennett without my friend interfering.

The Inspector: We cannot go into the estimates for Eastbourne and other towns.

Mr. Robb: I submit that it is necessary to show the sort of estimate on which the Local Government Board are asked to grant this loan. It is important that these points should be cleared up and the scheme put on a satisfactory basis. I will pass on to the question of depreciation.

Mr. Cripps: That is a matter on which there is a difference of opinion.

Mr. Robb: You say that the sinking fund does away with the necessity of a depreciation fund?—No I do not say that.

But here is your Eastbourne report?—My views on that point have changed.

Do you now suggest the sinking fund is sufficient?—No.

What do you mean then?—A depreciation fund is not necessary.

Why not?—Because I allow for repairs, and in 25 years the capital will be paid off, and the system belong to the Corporation.

There will be no depreciation to be allowed for in 25 years?—There will be repairs.

The Inspector: But how do you provide against the plant becoming antiquated if you have no depreciation fund? In 25 years much may become obsolete.

Mr. Robb: That is what I am trying to get out of Mr. Bennett.

Mr. Bennett: These changes are merely theoretical. In Tunbridge Wells we shall have our profits to fall back upon. I do not advise that profits should be spent in relieving the local rates.

Mr. Robb: You say the sinking fund is sufficient, and you do not want a depreciation fund?—It is no longer necessary.

But the sinking fund is to relieve the ratepayers of debt, so that new liabilities which come along may be met?—That is where I am converted to new views. I set aside the profits for eventualities.

But you do not contemplate a profit?—If there is, so much the better for the ratepayers.

You said that the question of renewals is more theoretical than practical. The telephone business has only been in existence about 20 years, and during that time the National Company has renewed its plant three times?—I cannot say.

Can you tell me any exchange using the same plant for over 20 years?—I saw some at Aberdeen that was in use 20 years ago.

Yes, but what kind of plant? Was it the same switchboard as 20 years ago?—I do not say that.

But where you have strong competition, and everything depends on efficiency, you cannot reckon on working with old plant?—The National Telephone Company move their old plant where there is no competition.

That does not help you. How are you going to keep up with the new plant which the National Telephone Company introduce?—That is to be seen.

Where you have competition the amount of depreciation will be increased?—No.

But you must be up-to-date?—Yes.

You can only do this by keeping pace with the National Telephone Company, and these allowances will seriously affect the financial outcome of your estimates?—I do not trouble about what the National Company do.

Can you give me an instance of a switchboard in use 20 years old?—No, I cannot.

Fifteen years?—No.

Do you know a switchboard 12 years old?—I am not conversant with the National Company's exchanges.

Is not the central battery system being largely introduced now?—It is; but I should not make use of it.

But you admit there are experts foolish enough to think differently from you. You do not make any allowance for renewals continually necessary in an up-to-date system?—There are modifications, of course.

To quote your own words, there is no standing-still in telephony?—We endeavour to prevent that.

There is a good deal not provided for in this £25,000?—There must be finality.

You said there was no finality in telephony?—No; but there must be in the application to the Local Government Board for the time being.

Is it not a peculiarity of the telephone business that nothing is final?

Mr. Cripps: We cannot help that.

How many branch switch rooms do you provide for £100 in your estimates?—15 or 16.

That works out at only 3s. rent each?—We should arrange to have rooms in cottages.

Cottages are not large enough for switch rooms, as well as families. What rent do you pay here?—The local manager will tell you.

Have you got any as low as 3s. per week?—I believe so. We have a special arrangement.

The Inspector: I take it that the object of the cross-examination is to show that the undertaking is not a paying concern.

Mr. Robb: My friend, Mr. Cripps, put in a profit and loss statement, which is only an estimate based on Mr. Bennett's unreliable estimate. There are a number of insulators in this town of one pattern?—Yes.

The Bennett pattern?—Yes.

Are they suitable for terminals?—Yes.

Have not a number of arms been pulled over by the excessive strain on the terminals?—Yes; a good deal of the work was done by contract in a hurry, and in a way we had to complain of.

How do you provide for work which has to be overhauled?—It comes under the heading of repairs.

Mr. Cripps: My friend was the solicitor for the contractor.

Mr. Robb: I, like Mr. Cripps, act in various capacities. Now as to maintenance, do you still say a man and a boy are sufficient for inspection?—Yes.

We have heard a great deal about Guernsey. Do you know the area there is 24 miles against 120 in Tunbridge Wells?—Yes.

Do you still say your comparison of the Guernsey area to the Tunbridge Wells one was a fair comparison?—There are more railway facilities here to counterbalance the area.

But a number of villages on your system have no railway communication.

Mr. Cripps: We have bicycles.

Mr. Robb: They are not in the estimates.

Mr. Bennett: It may be necessary to put another man on.

Then you revise your estimate in that respect?—We have just got candidates for the post of manager, consisting of men of long experience in the N.T.C., and we took the opportunity of their candidature to question them as to what the National Company did, and I am satisfied from their answers that——

Mr. Robb: That is only hearsay. We are dealing with estimates. In a scattered area like this, is it fair to expect one man to attend to more that 250 instruments?—We can get more men if we wanted them.

The Inspector: Do you provide for that in your capital?

Mr. Bennett: It is a percentage calculation.

Mr. Robb: There are a number of things like this included in a percentage calculation, instead of a detailed estimate. Such a calculation is not reliable.

The Inspector: If you have cheap work, the percentage must be increased.

Mr. Robb: What provision is made for bad debts?—I do not find it necessary.

The Inspector: I thought they paid in advance.

Mr. Cripps: Except the toll subscribers.

Mr. Robb: Then canvassing and collecting?—The canvasser is paid by results, and the subscribers pay themselves at the Town Hall.

You have only received 50 per cent. of your estimated receipts so far; then there is no allowance for engineer's fees?—They are charged to capital.

But will no further assistance be required from the consulting engineer?—I am always at hand.

I assume you would not come down here for nothing. What provision is made for these contingencies?

Mr. Cripps: Mr. Bennett would only be called in if there were an emergency.

Mr. Robb: Do you suggest that this competition is beneficial for the general body of the ratepayers?—I think so.

As about 160 people have to subscribe to both systems, it is no benefit to them?—They have the benefit of the cheaper rates of the National Company.

Having to use two systems means a good deal of trouble and confusion, as well as expense.—If one system breaks down, they have the other to fall back on.

Do you believe in a cut-throat competition, and cutting working arrangements down to the barest minimum?

Mr. Cripps: The National Company started the reduction of rates—not the Corporation.

Mr. Bennett: I do not bother myself what the other side do. I "do well, doubt not."

Mr. Cripps (to the Inspector): That is the borough motto.

Mr. Robb: You emblazon that on your instruments, with that inscription, in Swedish, of foreign makers. Do you think it fair for the Town Council to boycott ratepayers who find the National telephone suits their business best? Ought ratepayers to be cut off from the police and fire brigade?

Mr. Cripps: That is not a question for the engineer. It is purely a question of policy. The Corporation take every advantage to push their business, and by refusing to let residents who subscribe to the National Company have communication with the police, we get 200 more subscribers.

Mr. Robb: Is not the policy of the Corporation opposed to the policy of the Government, and of the General Post Office, who believe co-operation the most efficient system in the public interest? —(No reply.)

I think that your fees and travelling expenses amount to £1,000? —Yes.

Mr. Cripps: Those are charged on the ordinary scale:—Yes

Re-examined by Mr. Cripps: Thirty-two additional subscribers had been obtained since the last inquiry. When the system was started he did not imagine it would have such a phenomenal success. He provided a greater proportion of spare wires than 20 per cent. Glasgow started their exchange virtually at the same time as Tunbridge Wells, and Glasgow had had to make a similar application to the Secretary of State for Scotland to double the original application. The success had been so great that the Telephone Committee got the Town Council to apply for another loan, which was granted last week. It would be necessary to remodel and extend the present switchboard in 10 years' time. Assuming that the undertaking did not increase, it would not be necessary to alter or change the existing plant. The necessity for substituting improved plant would arise, if the undertaking went on prospering. At the end of 25 years the whole value of the plant would not be exhausted. Cables constituted £7,000 out of the £25,000, but at the end of 25 years they would not have depreciated to any appreciable extent. The cables would then be suitable for the purpose of the Post Office, if they purchased the system.

Mr. Robb claimed the Inspector's indulgence to ask one question. It was on the estimate of expenditure in the surrounding districts. Mr. Bennett provided for 55 subscribers, which were all that were immediately provided for, although there were junction wires. The immediate cost per subscriber was £48 per line, which was far in excess of the original estimate.

Mr. Bennett: Something like that, including junctions.

(To be concluded.)

CABLES FOR THE EMPIRE.

There is a certain measure of thanks due to the members of the Inter-Departmental Committee on Cable Communications which was appointed in November, 1900, for having at last decided to publish their first report, which was issued on 20th of last month. The fact that this report had been completed and signed six months before it was presented to Parliament in no way detracts from its value, as these six months seem to have been devoted to enlightening the individual Departments, and others closely connected, on the points which a joint consideration of outside evidence had taught these Departments as a whole. In this interim report the Committee write:—"We have learnt with much surprise," &c. That which calls forth this expression, which has the air of being even a rebuke, is only the discovery of a condition of things with which at least one of the Departments represented must, or should, have been perfectly familiar ever since the year 1878, and which, therefore, an Inter-Departmental Committee should not have been expected to look on with any amazement.

We have frequently, and for many years back, pointed out in our columns the necessity which existed for a revisal of the existing system of submarine telegraphs. This we have done as thoroughly, and insisted on as strongly, as the conditions would permit of. Many of the agreements, cross-agreements, &c., which have at last been examined into, and which we hope will shortly, in their completeness, come to the light of day in the final report of the Committee above referred to, have been a sealed book to us and to the public, and we are pleased to reflect now, that, in some modest degree, the revelations which have so much surprised the Committee are due to such analyses of rates, accounts, &c., as from time to time we have been able to lay before our readers. These —at any rate, so we are informed—have been largely the means of bringing into focus that force of public opinion, which, arising from the general dissatisfaction felt throughout Great Britain and the Colonies, has been so frequently and generally expressed by Chambers of Commerce and other influential bodies, culminating in the strongly supported protest made in Parliament by Sir Edward Sassoon and others during the past two years.

It would be tedious to enter now into much detail; but a glance at the position as it stood some few years ago and a recognition of the changes which have been brought about will not be out of place.

Attention has frequently been called to the fact that the strategic value of the existing cable system is not at all what it should be, nor what the demands, sometimes extremely urgent, of our widely scattered Empire render necessary. It was pointed out by Sir Edward Sassoon in a comprehensive address which he delivered at the Fishmongers' Hall two weeks ago, that:—

It has required two wars to provide us with the main lines which now exist to the Cape! We have to thank the Zulu war, of more than 20 years ago, for the cable which, assisted by heavy subsidies from Government, was laid down the East Coast of Africa to Natal, and we have to thank the present war to a very great extent for the laying of the cable from England to Cape Town *viâ* Madeira, St. Vincent, Ascension, and St. Helena, which was rendered necessary by the insufficiency of the cables in existence before the war broke out. Even these cables cannot be looked on as strategically perfect, as they both touch on foreign territory, and to reach England have to pass through the shallow water at the mouth of the English Channel, the dangers attending which locality have been pointed out by Sir Charles Dilke.

It might have been added that the cables to India have also to pass through Egypt, where once already we have had a lesson of how they can be cut in war time.

In this address it is further pointed out that owing to the exceptional position in which some of the existing cable companies stand, by virtue of the large subsidies and favourable agreements which they have succeeded in obtaining from the Home and Colonial Governments, their position is practically unassailable by unaided private enterprise, and that therefore as a remedy a complete system of State-owned cables should be established, as private competition has been put out of the question by the action of Government in the past.

We make the following extract from the address above referred to:—

To say nothing of the many other advantages which attach to cables belonging to the Government, we have the important fact that when such cables are also constructed by the State, the capital required can be raised at a low rate of interest; that the various expenses connected with company promotion are done away with, also that the cable can be bought in the best and cheapest market, and be made of the best material, and in the best way; and further, that the Government will be spared the expenditure of the large sums which, as we have seen, are frequently paid away in subsidies, besides which, large dividends will not have to be forthcoming. Beyond all this, it will be unnecessary to lay aside large sums to reserve, as is at present done by most of the companies, a reserve which they use as a war-chest with which to defy or crush competition; and lastly, the Government could also devote to the reduction of rates, the large sums which the companies at present expend out of earnings to extend their systems of cables.

These are the more direct and obvious advantages of State-ownership, but they are by no means the most considerable. With the cable systems of the British possessions under Government control, the tariffs could be so regulated and so much reduced, that the lines will be thrown open to the use of multitudes of our fellow-subjects, to the undoubted advantage, commercially and socially, of all the individuals concerned, and thus these cables will become a guarantee for the solidarity of the Empire in securing the perfection, as far as it is humanly possible, of this adjunct of defence and offence.

It has been urged that one great advantage of private as opposed to State ownership of cables is that the companies act as a buffer between the Governments interested, where cables touch on soil other than British, but that this argument is a futility is proved by experience, as there are at present some 1,200 miles of cable which His Majesty's Government owns in common with the German, French, Dutch and Belgian Governments.

As an example of the lack of foresight shown by the Governments when aiding the existing companies to fortify their positions, we take the following from the address with which we are dealing:—

As the original cable laid (in 1871) from Java to Australia was not working satisfactorily, the Australian Governments, to procure the duplication of this faulty line, agreed (in 1879) to pay the

company concerned an annual sum of £32,400 per annum for 20 years. Now this sum was sufficient—if the Governments interested had undertaken the work themselves, and borrowed the requisite capital at 3½ per cent., to have furnished the interest on a loan, and also to have established a sinking fund to replace the original capital in 20 years, the capital being £460,500, which is some £285,500 more than the cost of the cable in question, so that the Governments practically paid nearly three times the price of the cable! I have taken the value of this cable at the rate per mile given by the same company, as the cost of their new Hong Kong-Labuan-Singapore cable. In the above figures we have not included the large amounts to the credit of this cable from traffic earnings, after paying all working expenses.

From the above it will be seen that the need for a more intelligent State intervention in cable matters is a pressing one.

The reluctance which the telegraph companies display to reduce their charges to meet the claims of the public and the expansion of trade, when free from the healthy tonic of competition, has become proverbial. They have only surrendered under the greatest pressure of public opinion and the dread of the impending construction of the State-owned Pacific cable. The reduction of the rate to India, which on the first of this month was fixed at 2s. 6d. per word, after having remained stationary at 4s. for the last 16 years, has only been brought about by the very strong recommendations of the Inter-Departmental Committee.

This reluctance to meet the growing requirements of the community is all the more inexplicable, when we find that in the past almost every reduction in rates has resulted in a largely increased revenue to the companies.

Sir Edward Sassoon has formulated a scheme of State ownership in which much detail is given. This idea, which is it appears, only put forward as a reasonable basis on which the matter may be discussed, contemplates the laying by the State of some 22,000 miles of cable, and the purchase of some 59,000 miles of cable already existing, assuming, in the case of these latter, a term of 30 years as being the life of a cable. The total expenditure to the State is estimated at about £88,000,000. That the above estimate is a reasonable one we gather to be the case from the remarks of the chairman of the Telegraph Construction and Maintenance Company, who a fortnight ago, when recommending to his company a dividend of 20 per cent. for the year, and a sum of £91,000 to be carried forward, said in reference to the above scheme, that the price suggested as that at which to purchase the cables of the companies was "a very high figure." Sir R. G. W. Herbert should certainly be an authority on this subject, being not only the chairman of the company which makes and sells these cables, but also a director of one of the large purchasing companies.

Should the companies not fall in with the views expressed as to purchase, there is, of course, nothing to prevent the State from establishing a complete network of cables quite independent of those which already exist.

COMPARISON OF NERNST AND OTHER ELECTRIC LAMPS.*

The Nernst lamp has now reached a state of development, both in this country [U.S.A.] and abroad, where it may be seriously compared as an efficient electrical illuminant with incandescent lamps and with high tension and low tension arcs. It is difficult in a comparison to ascertain which type of lamp under like conditions will give the most favourable results from the viewpoint of economy, on account of the comparatively large differences between the specific efficiencies of single lamps of the same type.

In making comparative tests certain standards should be used, which should correspond with empirically determined mean values. Such a comparison is made by a writer in the *Elektrotechnischer Anzeiger*. He assumes that an incandescent lamp averages 3·25 to 3·75 watts per effective spherical candle, an open arc lamp 1·50 to 2 watts, an enclosed arc lamp 2·40 to 2·80 watts and a Nernst lamp of

* *Western Electrician.*

Table I.

Type of arc lamp investigated.	Amperes.	Pressure of arc in volts.	Theoretical power consumption in watts.	Real power consumption in plants of 110 to 220 volts in watts.	Mean spherical intensity relative to the lower hemisphere in candle-power.	Maximum candle-power.	Magnitude of the most favourable angle of light in degrees.	Practical consumption of power per candle-power of mean spherical illumination in watts.	Remarks.
Continuous current	3	36	108	165	86	120	37	1·92	On 110-volt circuit two lamps were connected in series.
Continuous current	5·5	40	220	302 5	168	218	35·5	1 80	
Continuous current	7	43	301	385	233	312	35	1·65	
Alternating current	6·5	27·5	178 8	238 5	119	167	33 5	2	Three lamps were connected in series on 110-volt circuit.
Alternating current	8·5	29	246·5	311 9	167	214	34·5	1·87	
Enclosed arc ...	3	75	225	330	118	158	31·5	2·79	Lamps on 110-volt circuit connected singly; on 220-volt circuit, two in series.
Enclosed arc ...	5	80	400	550	203	260	29·5	2·64	

Table II.

Style and size of test lamp.	Mean watt consumption of lamp.	Watt consumption per Hefner candle.	Cost in marks. [1 mark = 23·8 cents.] One lamp.	Rheostat (if separate from lamp).	Reserve glower.	Inner globe.	One pair of carbons.	For depreciation and interest on investment per lamp per annum, marks.	Average cost of generated 100 Hefner candles per 1,000 lamp-hours (mean spherical intensity), marks. Consumed energy.	Consumed carbons.	Replacing of glowers.	Renewal of incandescent lamps.	Attendance, including cleaning of lamps.	Repairs, regulation, &c.	Charge for depreciation and interest on investment per 100,000 generated candle-hours per annum, marks.	Mean cost per generated Hefner candle per hour, pfennigs.
Continuous current, 3 amps.	165	1 92	50	1/2	—	—	0·07	8·40	124 80	6 05	—	—	10	6	9·77	0 157
Continuous current, 5 5 amps.	202·5	1 80	55	1/2	—	—	0·10	9 22	117	9·09	—	—	10	6	5·46	0·148
Continuous current, 7 amps.	385	1 65	60	1/2	—	—	0·11	10 05	107·25	9·17	—	—	10	6	4·31	0 137
Alternating current, 6·5 amps.	238·5	2	60	1/2	—	—	0 11	9·00	130	9·17	—	—	10	6	8 07	0·163
Alternating current, 8·5 amps	311·9	1·87	63	1/2	—	—	0·12	10·05	121·55	10 06	—	—	10	6	6·02	0·154
Enclosed arc, 3 amperes ...	330	2·79	105	—	—	0·45	0·16	15·75	181·35	1 60	—	—	2	6	13·35	0 220
Enclosed arc, 5 amperes	550	2 64	110	—	—	0·45	0·17	16·50	171·60	1 70	—	—	2	6	8 05	0·206
Incandescent, 220-volt, 16 c.p.	59	3 70	0·60	—	—	—	—	1	240·50	—	—	6·25	0·10	—	—	0 247
Incandescent, 220-volt, 25-c p.	96	3 84	0·60	—	—	—	—	1	249 60	—	—	4	0·10	—	—	0 254
Incandescent, 110-volt, 16 c.p.	51	3 19	0 50	—	—	—	—	0 84	267·35	—	—	5·25	0·10	—	—	0 213
Incandescent, 110-volt, 25 c p.	81	3 24	0 50	—	—	—	—	0·84	210·60	—	—	3·36	0·10	—	—	0·214
Nernst lamp for 210 watts ...	176	2 15	12 50	—	2	—	—	6	139·75	—	7 32	—	1·20	—	1	0·149

the larger type, 2·15 watts. The arc lamps are supposed to be of a medium or small type, with nearly transparent globes. In Table I. are given the results of the investigations of the writer and other authorities on arc lamps.

Of importance in this table are the values of the specific consumption of power. The enclosed arc lamps had inner and outer globes of translucent glass. The Hefner candle is used as the unit for the candle-power measurements. It is apparent from the table that the Nernst lamp, with a watt consumption of 2·15, ranges in consumption of power between the arc lamps of high potential (enclosed arc) and those of low potential.

Considering in the case of arc lamps the consumption of carbons, the replacing of globes, repairs and cleaning; in the case of Nernst lamps the replacing of glowers and the very small amount of repairs and maintenance, and in the case of incandescent lamps, the renewal of lamps, the data in Table II. have been compiled.

The depreciation and interest on the investment are figured together at 15 per cent. in the case of arc lights. The prices for carbons are average market values in Germany for the better grades. The cost of energy is taken at 65 pfennigs (15·5 cents) per kilowatt-hour and labour at 30 pfennigs (7·1 cents) per man per hour. The prices for the Nernst lamps and the reserve glowers are those of the Allgemeine Elektricitäts Gesellschaft, of Berlin. The possible differences of the respective costs of installation, &c., have been neglected, as too small factors. A life of 330 hours is assumed for the Nernst lamps and 600 hours for the incandescents.

ARMATURE INTERFERENCE AND BRUSH POSITION.

By H. M. HOBART.

(*Continued from page* 331.)

Backward Brush Lead in Generators.

All the preceding propositions have evident present commercial interest, and have been substantiated by actual experimental tests. The writer is convinced, however, that we have now so much more definite knowledge of the conditions relating to the general subject of reactance voltage, brush position, and commutation as to justify giving most serious consideration to a proposition which would, a few years ago, have been necessarily dismissed as possessing no prospect of commercial practicability.

It has already been demonstrated that the reactance voltage may be made so low as to permit of departing altogether from the principle of employing an impressed magnetic field to reverse the current in the short-circuited coil. This has been done in cases where the conditions are inherently less trying, as in railway motors, where, as already described, the frequency decreases with the load, and in rotary converters, where the armature reaction is, at unity power-factor, practically absent. We should now go a step further, and, employing very low reactance voltage per segment, give the brushes a suitable *negative* lead, thus enabling the armature magneto-motive force to supply, wholly or in part, the desired compounding or over-compounding in proportion to the current output. With armatures of sufficient strength, estimated in terms of the armature ampere-turns per pole-piece, we may dispense altogether with the series winding on the magnet poles and derive the compounding from the armature current, certainly a very suitable method from the standpoint of the consideration that the required magneto-motive force is supplied in the armature winding itself, where we wish the increase to be proportional to the current output; and, furthermore, the method should lead to a very appreciable saving in copper and iron, since the series coils are dispensed with, and the magnet core may be proportionately shorter. The C^2R losses in the series coils are also avoided.

A machine most suitable for this purpose would, in the writer's opinion, be characterised by an armature short axially (*i.e.*, in the direction of the shaft) and of large diameter, with very many rather narrow segments and generally but one turn per segment.* The magnetic and current densities would be extremely high, chiefly for the purpose of obtaining the lowest practicable reactance voltage; this would, however, have the further advantage of resulting in a machine of very moderate first cost, due to the high armature strength and high current density, although of rather low full-load efficiency. The efficiencies at light loads would tend to be higher than in customary types, as the weight of armature laminations would be so low that even with the comparatively high specific loss in the iron, the total core loss would be fairly low. Backward lead machines should be built with very strong armatures, as this serves to produce the necessary magnetisation with a minimum number of segments backward lead, and also greatly simplifies the problem of obtaining a design with a very low reactance voltage per commutator segment.

The results obtained by the writer have been extremely satisfactory as regards the power of low reactance voltage machines to carry great overloads without sparking, with the brushes in the geometrical neutral position. These machines had comparatively weak armatures, and hence would not have compounded with negative lead, although tests on them, in this respect, would have revealed a still further improvement in their inherent regulation. The observations, however, strengthen the belief that magnetisation by strong armature and backward lead may be made thoroughly consistent with satisfactory commutation without departing from ironclad constructions, and such constructions might continue to be found preferable even for backward lead generators. There are, however, directions in which we may still further decrease the reactance voltage, and if such further decrease should be found necessary, the construction would be on the following plan: In addition to the short, large diameter armature and commutator, the numerous commutator segments and the high magnetic flux and current densities, the armature conductors would be of stranded copper located at or near the armature surface. This could be arranged mechanically as strongly as if the conductors were embedded, by having non-magnetic manganese steel, low conductivity

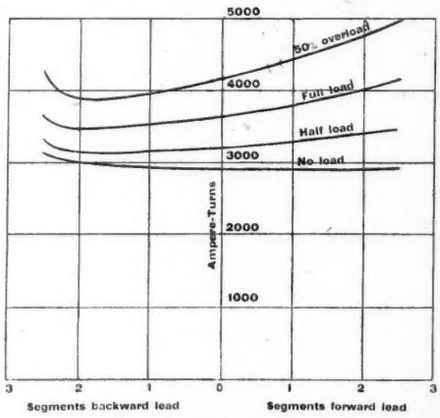

Fig. 2.—Excitation Curves for 110 Terminal Volts and 700 r.p.m.; Field Excitation Plotted against Brush Position.

discs projecting above the surface of the effective laminations at several points of the length of the armature. These discs would be constructed of such shapes as to, at the same time, serve to provide ventilating ducts at their sides. The non-magnetic discs would have suitable numbers of equi-spaced slots, just like ordinary armature discs for slotted armatures. By these various means it would become easily practicable to secure reactance voltages of one-half, or even less, of those in good machines of the usual constructions. Relieved of the necessity of finding room for the series coils on the magnet cores, one could afford to increase the amount of shunt copper, thus overcoming the longer air-gap and the

* The practicability of employing but one turn per segment is of course increased, the larger the normal output and the lower the normal voltage.

high densities generally. There should be a wide neutral zone, the space between pole tips not being more than, say, 50 per cent. of the pitch. This last point is one of some interest. In the tests on the 17-KW. dynamo, of which some of the results were given in fig. 1, observations taken with a still greater negative lead—2½ segments—showed an *increase* in the excitation required for maintaining the voltage. This was evidently due to the insufficiently wide neutral zone, as

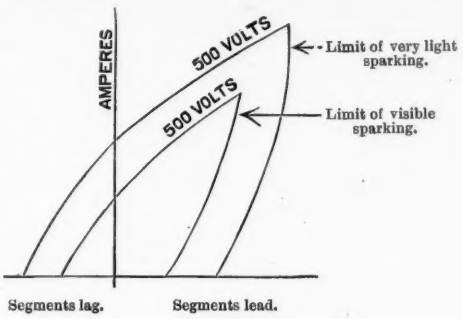

Fig. 3.

a consequence of which, with the larger backward lead, the armature coils failed to embrace the total flux entering the armature per pole-piece, or, rather, in that position, part of the flux from two poles of opposite polarity entered the armature coils. The results are given in fig. 2.

Such a project is more difficult to consider, because the experimental work available on commutation and regulation, although extensive, does not, to the writer's knowledge, yet include curves bearing on the points of the greatest interest for this purpose. Tests on the lines indicated by the accompanying hypothetical curves (see figs. 3 and 4) would be of especial value.

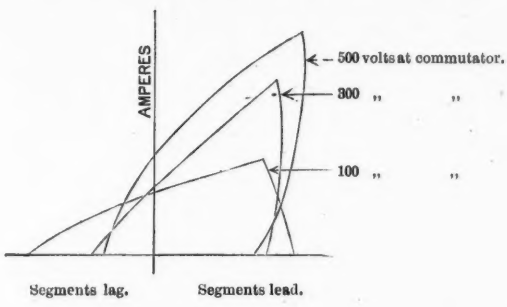

Fig. 4.

(To be continued.)

THE TESTING AND MANAGEMENT OF ELECTRIC MOTORS.

By P. T. WHITE, Wigan Electricity Works.

(Continued from page 9.)

With reference to compound motors, it may be useful to bear in mind that, unlike compound dynamos *with the same connections*, the field magnets receive the difference only of the effects of the shunt and series windings. There are, notwithstanding the loss in efficiency, certain advantages to be gained by the employment of these "differentially-wound" motors, even though the demagnetising coils may have, and, indeed, often have in practice, a value of one-fifth of the magnetising coils in ampere-turns. This statement, however, must not be taken to imply that the field-magnet losses are proportionally so high, as in such calculations the demagnetising effect of the armature with negative brush lead must be taken into account. In all compound motors the ampere-turns of the shunt, and consequently its magnetising effect, must preponderate.

In the coupling up of these motors, if any doubt exist in the mind of the motor installer as to the proper connections, he can easily assure himself by starting up with the "shunt" out. The motor will then, following the law of the series machine, run in the reverse direction. The fact that the torque of a series motor depends only on the current will, if kept in view, make him careful in the matter of speed.

One of the greatest obstacles in the path of the man of little experience in the employment of motors for power purposes is the correct estimating of the power required for various drives, and it may be said in nearly all cases he will err on the wrong side—insufficient power. In these circumstances it may be some consolation for him to know that he is in the company of many machine tool makers and manufacturing engineers, whose conservative opinions on this subject are a matter of wonderment to the initiated. An ammeter—for convenience one of the shunted type is to be preferred—should always be employed in the motor circuit for testing purposes when starting up new work. It will be found extremely useful.

It has been said, and the fact is so obvious to the experienced that some apology is necessary for its reiteration, that the efficiency of a motor falls with increase of load. For this reason it will be evident that an ammeter reading, as an indication of power required, is apt to be misleading. A four-horse motor overloaded to, say, 80 per cent. of its rated power, will not give by any means the same reading as a ten-horse on the same load. This should never be lost sight of.

There can be but little doubt that considerable laxity prevails as to the proper application of apparatus designed to safeguard motor circuits. I have no intention of dwelling upon that vexed question, the type of starter to employ, but I shall go so far as to say that experience has taught me to favour those types employing wire resistances. Liquid starters, of which we heard so much some years ago, are subject to many vices, principal among which are :—The "creeping" of the solution ; the uncertain action of their "air" and "oil" valves ; their low insulation ; "dead shorting" of the motor armature owing to misconception of the position of the starter handle ; the absence of "no voltage" releases, &c. It is now, however, pretty generally specified by supply engineers that starters should be equipped with "breakers" for low volts and overloads. Also it may be said that maximum circuit-breakers having a time lag are beginning to be looked upon with favour.

While upon this subject of starters, I feel compelled to utter a protest against the many vile contraptions, mostly of foreign origin, which are, from time to time, so successfully foisted upon the British market. It is an affront to the commercial ability of our home manufacturers—who cannot even advance the plea that these apparatus are cheap—and also, in no small measure, to their responsible engineers, whose remissness in the matter of the small details which go to make their productions a success is altogether unaccountable. These strictures apply, not only to starters, but to many other forms of apparatus and accessories in general use. We are all familiar with the sweating socket or the screw terminal, intended to take, say, a $\frac{1}{16}$ cable, which by no earthly means can be made to accommodate one half the number of conductors : the circular insulating bushing which naturally slips round though it should not : the absence of lock-nuts in many places where they should be : the tiny screw, which vibration and excessive strain soon depose from its position : the un-get-at-ableness—without pulling to pieces the whole apparatus—of many parts, which should be easy of access, and so on.

English designs of starters are, as a rule, on good lines. Their chief object seems to be the starting of a motor, even under load, so that the armature current can never exceed a certain figure, which figure is usually taken to represent the rated amperage of the machine. In the achievement of this object, however, they frequently get burnt out. This usually occurs when the starters are in frequent operation with little or no time between each operation. Some firms of the invasion type claim that their starters cannot be burned out, and they are right in their contention. Nevertheless, it is better to burn out the starter than the motor.

It is, however, in the matter of fusible cut-outs that the

greatest laxity prevails in supply stations. I think I can best illustrate my meaning by giving a hypothetical case. Let us say that a corporation is called upon to supply energy for 10 motors ranging from 1 H.P. up to 50 H.P. for one workshop. Let us further assume that the assistant making the official inspection decides upon putting a 200-ampere fuse into the service boxes. Now, if the motors are the property of the corporation there is set up a condition of affairs tending to abuse. I have seen stout and substantial iron wires in 1 H.P. fuses. The moral of all this is that service fuses should be "wayed" for the number of motors they control, and carefully sealed up. Little or no dependence should be placed upon exposed circuit-breakers, as they are always liable to be tampered with.

(To be concluded.)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1902.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.

4,581. "A new or improved method or means for securing fastening or locking cap or top to glass in the construction of incandescent lamps." J. Thornhill. February 24th.

4,593. "Improvements in annunciators." F. B. Herzog. February 24th.

4,596. "Improvements in electric automatic switches for motor-starting rheostats and the like." E. B. Wedmore. February 24th.

4,608. "An improved receptacle for watches in connection with a source of electric light." C. Arnold. February 24th. (Complete.)

4,623. "Method of cutting out large quantities of electrical energy, in particular when of high voltage." Siemens Bros. & Co., Limited. (Siemens and Halske Aktien Gesellschaft, Germany.) February 24th. (Complete.)

4,631. "Improvements in mantles or coverings for carbons of electric arc lamps." C. D. Abel. (Gebruder Siemens & Co., Germany.) February 24th.

4,640. "Improvements in or relating to enclosed or open type arc lamps for working on the direct or alternating current circuits." D. R. Broadbent. February 24th.

4,645. "Improvements in the manufacture of rail bonds for electric railways." G. G. M. Hardingham. (Felten & Guilleaume Carlswerk A. G., Germany.) February 24th.

4,648. "Improvements in electrical cut-outs or fuse boxes, feeder pillars, and other devices for the inter-connection of a number of conductors." F. A. Pocklington. February 24th.

4,664. "Improvements in electroliers." E. J. Williams and A. N. Rye. February 24th.

4,704. "Improvements in the poles of dynamo-electric machines and motors." W. R. V. Marshall. February 25th.

4,720. "An improvement applicable to the trolley poles of electric cars." W. Buckley. February 25th.

4,729. "Improvements in and relating to electric incandescence lamp-holders." C. E. Knowles. February 25th. (Complete.)

4,754. "Improvements in field magnets for dynamo-electric machines or electric motors." R. Lundell. February 25th. (Complete.)

4,755. "Improvements in incandescent electric lamps." E. McQuat. February 25th. (Complete.)

4,763. "Improvements in arc lamps." W. Crudgington. February 25th.

4,782. "Improvements in telephones." A. B. Tubini. February 25th.

4,783. "Improved switch for operating electric currents." F. Rawlings. February 25th.

4,793. "Improvements in intercommunication telephone systems." T. Sloper and I. H. Parsons. February 25th.

4,794. "Improvements in cut-outs for use in connection with overhead conductors for electric traction." J. F. Magoris. February 25th.

4,894. "Improvements in high voltage electric interrupters." O. Konitzer. February 25th.

4,805. "Improvements in electro-dynamometers." R. Ziegenberg. February 25th. (Complete.)

4,819. "Improvements in brakes for dynamometers." J. Edmonton, W. A. Purdom, J. W. Dawson, and Edmondson & Purdom, Limited. February 26th.

4,861. "Improvements in devices for overcoming alternating electric currents in direct current circuits." A. N. Gotendorf. February 26th.

4,865. "Improvement in automatic circuit breakers of induction apparatus." V. Barreto. February 26th.

4,871. "Duplex link chain for electric fittings." M. Railing and G. H. Ide. February 26th.

4,896. "Improvements in or relating to induction coils." G. Bowron. February 26th.

4,936. "Improvements in or connected with conduits or pipes for electric cables and the like." W. Oates. February 27th.

5,010. "Improvements in electric meters." A. Blanchet. February 27th.

5,018. "Improvements in the construction of two-fluid electric batteries." J. W. McKenzie. (La Société Anonyme L'Eclairage Electrique sans Moteur, Belgium.) February 27th.

5,032. "An improved electric pole-change for use in railway signalling." J. P. O'Donnell and E. C. Irving. February 27th.

5,043. "An improved trolley frame or bracket and head combined for use in electric overhead tramcars and the like." W. Hunt. February 28th.

5,057. "Improvements in and connected with telephone transmitters or microphones." H. Oppenheimer. (A. G. Mix & Genest, Germany.) February 28th.

5,065. "Improvements in overhead electric trolley wires." J. P. Cribb. February 28th. (Complete.)

5,071. "A combined arm rest, memo. paper, and pencil holder for telephones, and the like." J. Everett. February 28th.

5,083. "A maximum demand indicator for electrical supply." T. W. Graves. February 28th.

5,095. "Improvements in conductors for electric traction." E. H. Tyler. February 28th.

5,103. "An improved method of and apparatus for connecting the conductors or armour of electric cables and the like to junction boxes, earth plates and other parts." Callender's Cable and Construction Company, Limited, and J. C. A. Ward. February 28th. (Complete.)

5,104. "Improvements in the electric arc in electric arc lamps." La Societe G. et P. de Mestral. (Date applied for under Patents Act, 1901, September 4th, 1901, being date of application in France.) February 28th. (Complete.)

5,118. "Manufacture of new or improved material suitable for electrical insulating purposes." J. G. Maardt. February 28th.

5,129. "Improvements in electric commutators." W. Loewen. February 28th. (Complete.)

5,134. "Improvements in the electro-deposition of metals." S. Cowper-Coles & Co., Limited, and S. Cowper-Coles. March 1st.

5,147. "Improvements in and relating to electric trolley collectors." E. W. Wynne. March 1st.

5,190. "Improvements in and relating to electric switches and to combinations of the same with wall-plugs and the like." A. Vandam and T. H. Marsh. March 1st.

5,211. "An improved manufacture, or production of electrical conduits, drain-pipes, and the like." R. Lawton and The Albion Clay Company. March 1st.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d (in stamps).

1900.

10,312. "Improvements in and connected with wireless telegraphy." C. E. Wilson, U.S.A. Dated June 5th, 1900. Systems of wireless telegraphy, in which the aerial portions are arranged as far as possible from the signalling instruments by means of captive balloon or box kites. A captive balloon is arranged with the vertical aerial wire surmounted with a ball and connected to the secondary of the transformer in the car through a vacuum tube. Two transformers are shown in this arrangement, the secondary of the signalling transformer being connected to the primary of the aerial transformer; both secondaries are connected to earth. When only one transformer (aerial) is employed, two separate connections with the balloon are necessary. 4 claims.

10,270. "An arrangement in voltaic battery for use in fixing explosives." G. Evans. Dated June 5th, 1900. Relates to batteries for shot-firing or blasting in mining, quarrying, or like operations, and has for its object to prevent accidental ignition of the charges. For this purpose, the terminals have flat or other suitably-shaped heads which offer no place of anchorage for the cables or wires, which have to be held against the terminals by hand in order to maintain the contact. The battery is provided with straps so that it may be slung over the shoulders. 1 claim.

10,273. "Improvements in controller regulators for electric motors." H. J. Haddan. Dated June 5th, 1900. A controller for electric motors is provided with mechanism for ensuring a step-by-step movement of the controller handle, which only permits the movement from step to step after a pause, the length of which may be prearranged by a suitable adjustment of the apparatus. 8 claims.

10,312a. "Improvements in and connected with electric wireless signalling." C. E. Wilson, U.S.A. Dated June 5th, 1900. Buoys are provided with automatic alarm apparatus for emitting code signals by wireless signalling for indicating their individuality. The buoy is preferably provided with two external electrodes immersed in the sea-water, but may have an internal battery either auxiliary to or in substitution therefor. The generator is connected in a local circuit with the primary of an induction coil, a driven code contact wheel and an electrolytic or other interrupter. The secondary of the induction coil is connected to a radiating rod and ball surmounting the buoy and to the earth or water. 4 claims.

10,318. "Improvements in electric storage batteries and conducting plates therefor." J. C. Fell. (S. L. Wiegand.) June 5th, 1900. Relates to that form of plate or electrode which consists of a conducting plate having different polarity on opposite sides, and the invention consists broadly in insulating the opposite sides of the plate from each other by liquid or fusible materials which are placed in a trough or troughs formed in the rim of the plate, the troughs being protected from the entrance of electrolytic liquid. 14 claims.

10,319. "Improvements in electric storage batteries." J. C. Fell. (S. L. Wiegand, U.S.A.) Dated June 5th, 1900. Relates to plates or electrodes which consist of a conducting plate having active material of different polarity on its opposite sides. The invention consists in making the plate with a hook-shaped rim, around which is cast a fusible frame of insulating material composed of sulphur, resin, talc, and wax, but the sulphur and the talc may be omitted. The frame may be made with tongues and grooves, to facilitate the fitting together of the electrodes in a superposed series, and is also provided with a flange which forms a boundary for the active material which is spread in the enclosed space. On the active material which is spread on the upper side of the plate is placed a layer of absorbent material, such as carbon or sand, which is saturated with the electrolyte. A sheet of asbestos, felt, or paper may be placed on the material, and another layer of absorbent material is placed on it. Vents connected to pipes are made in the frame, and serve both for supplying electrolyte and as gas exits. If the tubes are made of conducting material, they are insulated from each other, and may be used as a connection to test each electrode and locate any fault. If the tubes are made of insulating material, they may be filled with a conducting liquid for the aforesaid purpose. When a battery composed of a superposed series of these electrodes is in transport, they are placed in a case into which is then poured a non-conducting liquid, such as oil, paraffin, a mixture of oil-resin, or a composition more fusible than that of the frames which, if a rim should crack or break, prevents the outflow of the electrolyte, and the consequent short-circuiting which would then occur. Clamps and screws, or springs or weights, are used to hold the rims in close contact with each other in the casing. 8 claims.

10,323. "Improvements in telephone cables and in apparatus for producing same." H. Cassirer. Dated June 5th, 1900. Conductors for use in telephone, &c., circuits are provided with open spirals of straw, paper, &c., between the conductor and the insulating envelope. An apparatus for applying such a strip, and at the same time twisting it into a tube or cord, is as follows: The conductor passes through a fixed tube mounted in a bracket, and having a grooved disc. The disc rotates on the tube, and carries a spool of paper, &c. The spool is axially rotated by means of the cord. 3 claims.

10,348. "An improved electro-magnetic motor." J. van der Ploeg. June 6th, 1900. The motor consists of a pair of electro-magnets attached to an oscillating beam, and a second pair of fixed electro-magnets arranged opposite to the first pair. The upper magnets are excited so as to produce like poles by means of a current supplied from a battery in the manner shown. The lower magnets are excited so as to produce unlike poles by a current derived from the same source, and the direction of this current is periodically reversed by means of spring contacts acted on by a switch lever. To increase the force of attraction between the magnets, these cores are tapered at the ends so that they overlap each other. 3 claims.